Light and

LIGHTING

SEPTEMBER,

Light and
LIGHTING

Vol. 49. No. 9. September, 1956

Published by The Illuminating Engineering Publishing Co. Ltd. on the 1st of each month at 32, Victoria Street, London, S.W.1. Telephone: ABBey 7553. - Subscription rate 25s. per annum.

contents

Writing About Lighting

AS a journal devoted to the written word about lighting, we have the best of reasons for publishing—as we do this month—an article on the vocabulary of lighting, written by an acknowledged master of the art of writing about lighting. Linguistic laxity in the attempt to communicate facts and ideas either throws an unfair burden on the reader who, for what the author has written, must try to read what he should have written, or it leaves the reader in doubt if it does not actually lead him astray. The comparatively young technology of lighting has taken over some colloquial words and given them special meanings for its purposes; it has also coined some new words. The latter is perfectly legitimate and very necessary; the former may be less defensible and can easily be confusing. " If it happen to be necessary to explain some . . . subjects by new-invented terms, it will follow that you must frame words never heard of by the old-fashioned . . ." (*Horace*), but then you must take care of their usage.

Notes and News

OUR recent issue on church lighting met with much praise; which is very satisfying to us because we put a lot of work into it. So successful was it that the one copy we have left is chained to the desk. To meet orders which are still coming in for copies we are reprinting the 24 pages containing this feature which we have been told on good authority is the best survey of the subject that has been published.

Brussels, 1958

The Brussels International Exhibition, which is to be held between April 17 and October 19, 1958, will be the first exhibition of its kind since the New York World Exhibition in 1939. It will occupy a site of nearly 500 acres on the outskirts of Brussels incorporating the Heysel Plateau and the Centenaire buildings to which will be added many new halls and pavilions and where the grounds have been redesigned. It is expected that some 50 nations will be participating.

The British site of about five acres will consist of two separate parts—a Government pavilion and an industrial section comprising a pavilion and supporting features. The co-ordinating architects for the whole British site are Howard V. Lobb and Partners and the co-ordinating designer is James Gardner.

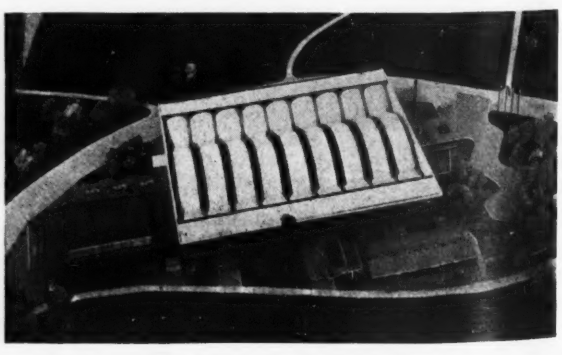
The aim of the Government pavilion is to show against a background of past achievement something of what Britain is doing to-day to contribute to world civilisation. On entering the pavilion visitors will see a dramatic display of ceremonial regalia, which will no doubt appeal to the many foreigners who admire our great heritage and traditions. Other exhibits will show what we are doing in the fields of nuclear energy and pure and applied science. Visitors will also get an idea of what we are doing in such matters as interior decoration, the building of new schools and of homes and of town planning.

The industrial pavilion is the responsibility of the Federation of British Industries through its subsidiary company British Overseas Fairs Ltd. The architects are Edward D. Mills and Partners and the interior designers are John Lansdell and Arthur Braven.

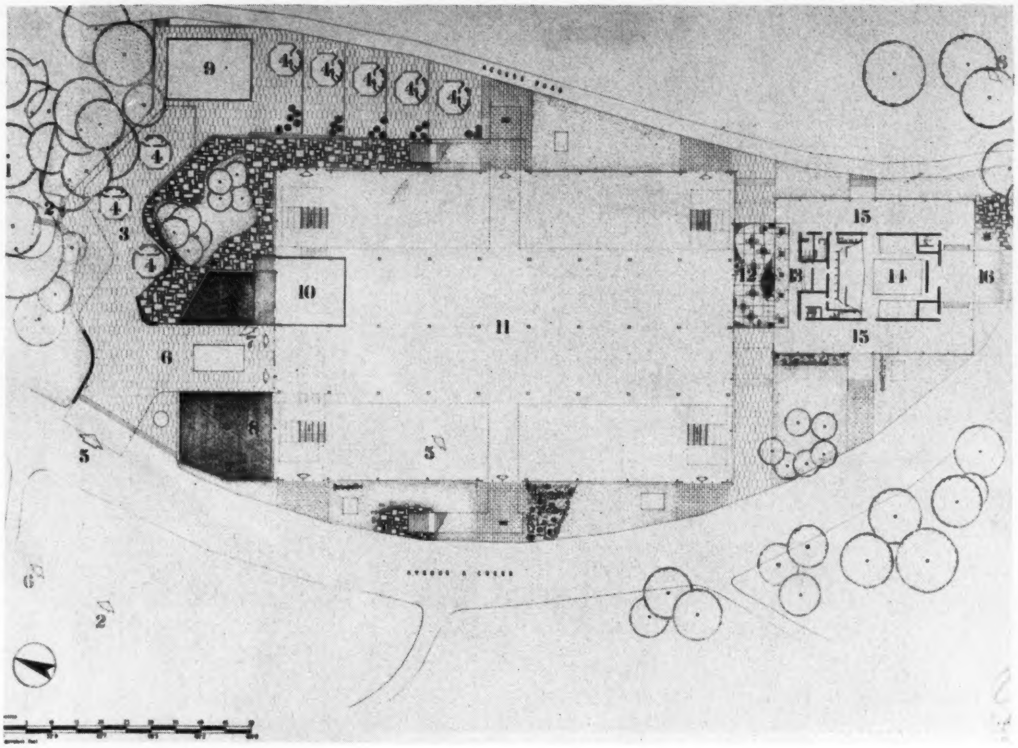
The industrial section will be in three main units the first of which is the pavilion itself, which will be 90 metres long, 60 metres wide and 15 metres high, giving approximately 100,000 sq. ft. of exhibition space. Thematic displays will cover all aspects of British industry. The second unit will consist of a paved area with trees and landscaping including a number of shops and a contemporary British pub. A feature of this area will be a large pool lit at night and a specially designed vertical feature in the form of a television mast which will serve television displays in the building. The third unit adjoining the main pavilion to the south will be a cinema seating 250-300 people and surrounded by a wide enclosed promenade which will also be used for display purposes.

The pavilion will be steel-framed with a roof of lattice tubular steel covered with light sheeting with roof lighting for the upper floor. The external walls will be mainly of glass. The buildings and garden will be flood-lit at night and special lighting is being designed for the interior of the pavilion so that at night, when the pavilion itself will be closed though the grounds will be open to the public, the building will become a vast, well-lighted shop window. Considerable use of lighting and colour will be made throughout the British exhibit and no doubt throughout the whole of the exhibition.

The cost of the industrial pavilion and its supporting features is given as £750,000; the total cost with exhibits is likely to be about £2 million. So far about one-third of the exhibition space in the British industrial pavilion has been sold and about half of the remainder is now being negotiated. It is expected that some 175,000 people will visit the exhibition each day and that the total attendance will be around 30 million from all parts of the world. It is to be hoped that the British lighting industry will be well represented at Brussels in 1958 to take advantage of this opportunity; in the opinion of the experts it will be at least another six years after 1958 before any country will be able to put on another such international exhibition.



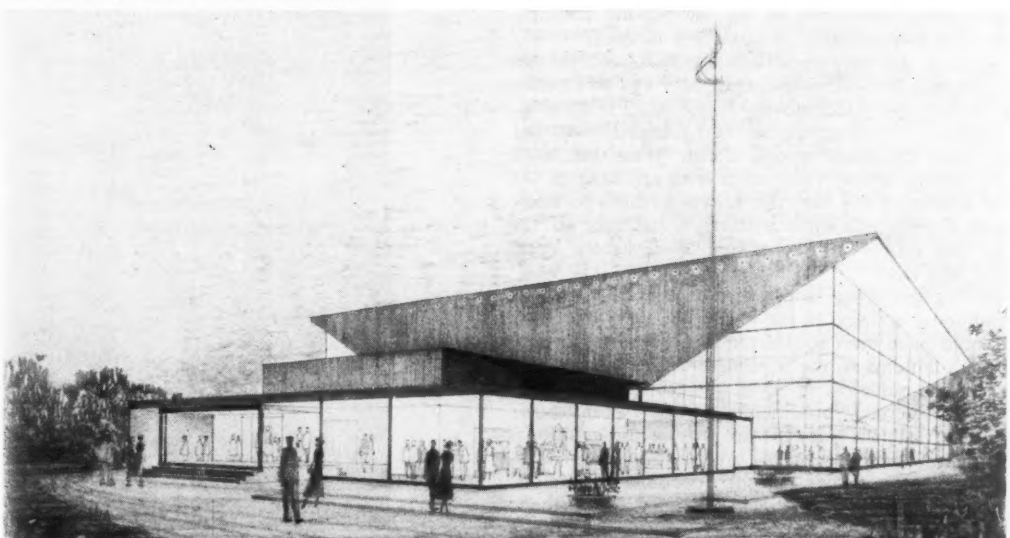
As from October 1 the price per copy of *Light and Lighting* will be 2s. 6d. and the annual subscription will be 30s.

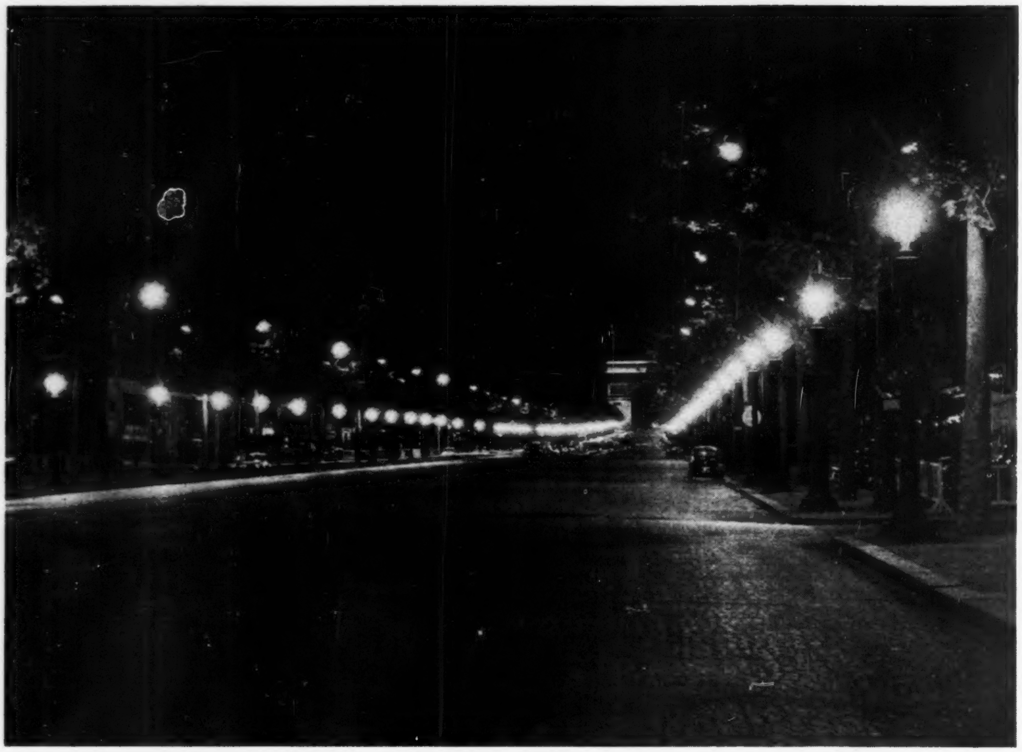


Ground floor plan of industrial pavilion—

1. *Official pavilion.*
2. *Entrance from official pavilion.*
3. *Covered way.*
4. *Shops.*
5. *Principal entrance.*
6. *Historical introduction.*
7. *Pool.*
8. *Vertical feature—television mast.*
9. *Inn.*
10. *Self-service shop.*
11. *Main hall.*
12. *Enclosed garden.*
13. *Bar.*
14. *Cinema.*
15. *Exhibition foyer.*
16. *Entrance to cinema.*

Night view of the pavilion from the south-east.





The Champs-Elysées looking towards the Etoile.

Lighting of the Champs-Elysées

One of the old columns.

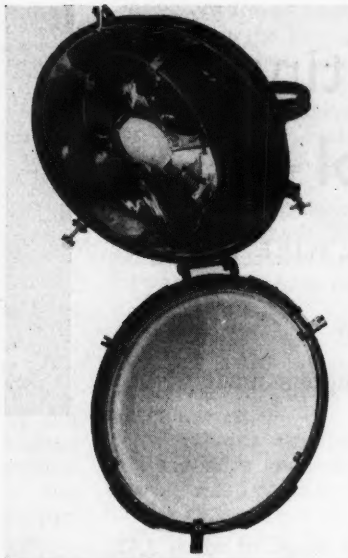
A new lighting installation on the Avenue des Champs-Elysées in Paris was switched on at the end of May.

The previous gas lighting installation had been in use, with some modifications no doubt, since 1859 and was hardly adequate for the heavy fast-moving traffic using this world-famous avenue. The relighting of the Champs-Elysées has frequently been discussed during recent years but until recently no scheme which would meet with approval on the grounds of aesthetics has been put forward. All who know the Champs-Elysées will agree that the appearance of the avenue by day should not be ruined by unsightly street furniture of any kind.

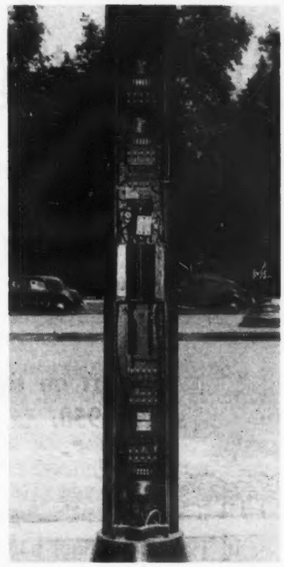
The existing gas lamps and columns have become part of the traditional scenery of the Champs-Elysées and their removal would have been considered a sacrilege. The conversion of the lanterns to use a modern light source would not, however, be sufficient in itself to light the very wide carriageway (27 metres). Additional lighting was obviously required. The problem was how to provide the additional lighting, which would necessarily involve the use of high columns, without introducing unsightly columns or lanterns. The choice of light source was also restricted for aesthetic reasons.

The problem was tackled jointly by the Technical Department of the City of Paris and the Street Lighting Department

One of the new columns.



The new lantern housing one tungsten and one colour-corrected mercury lamp.



Showing how the control gear is housed within the narrow column.

View of the Champs-Elysées from the Arc de Triomphe.

of Electricite de France. Beginning in April, 1955, tests were carried out on a part of the avenue using colour-corrected mercury lamps and fluorescent lamps. It was eventually decided to use a hemispherical-shaped lantern housing a combination of colour-corrected mercury and tungsten lamps to give a good colour rendering. The design of column agreed upon is of fluted steel dividing at the top into two curved arms each carrying one lantern. The columns and arms have a bronze finish. The height of the lanterns is 8.5 m. (27 ft. 6 in.). The lanterns on the road side house one 250-watt (10,000 lumens) colour-corrected mercury lamp and one 500-watt (9,000 lumens) tungsten lamp; those on the pavement side house one 125-watt colour-corrected and one 300-watt tungsten lamp.

The old installation gave an illumination of about 0.1 lm/ft^2 along the axis of the road; the new installation gives 2 lm/ft^2. The columns are spaced at between 22 and 28 metres (approximately 72 to 91 ft.).

The old gas lanterns have each been equipped with one low wattage colour-corrected lamp and one tungsten lamp. Their function is mainly decorative.

In the base of each of the tall columns is housed the control gear for the lanterns on that column and also the control gear for the lamps in the converted old lanterns on either side.

The columns and lanterns were supplied by the Societe Saunier Duval, the colour-corrected mercury lamps by Claude, Paz et Silva and the Compagnie des Lampes Mazda, and the incandescent lamps by the Societe Visseaux.

Street Lighting in Blackpool

By H. CARPENTER, M.I.E.E., F.I.E.S.

A report on the progress made since 1950.

The Promenade, Blackpool.

In 1950 Blackpool had 9,799 lamps, of which 3,421 (35 per cent.) were electric and 6,378 gas. The electric lamps were mostly tungsten filament, the gas lamps mostly antiquated; and the total luminous output of the lighting in operation was approximately 18,250,000 lumens, averaging 2,880 lumens per electric lamp and 1,450 lumens per gas lamp.

On March 31, 1950, 3,364 electric lamps were in operation (57 out of service) comprising 3,086 tungsten lamps, mostly 100-500 watts, and 278 mercury-vapour lamps mostly 400 watts. 5,969 gas lamps were in operation (409 out of service), mostly 10.8 and 6.0 cu. ft. per hour. 2,479 electric lamps were on part-night lighting and 942 on all-night; 4,846 gas lamps were on part-night lighting and 1,532 on all-night. Table 1 shows the operating costs in 1949-50. At the present-day level of prices, the estimated operating cost of a similar electric lighting installation would be £19,670 (£5.75 per lamp) and of a similar gas lighting installation £75,580 (£11.85 per lamp)—a total estimated operating cost of £95,250 (£9.72 per lamp).

Planning

The first essential in replanning the lighting was to survey the town and prepare, on a broad basis, and in order of priority, a programme of future lighting requirements for roadways totalling 275 miles in length (of which nearly 20 miles were unlighted) made up of 19.7 miles (Class 1), 9.4 miles (Class 2), 11.4 miles (Class 3), the remainder being unclassified.

The pattern of the relighting programme was, briefly, as follows:—

Main Roads

Because of its geographical location, Blackpool has no trunk roads. Reference to Fig. 1 shows that there are two main arteries into the town, from Preston and the south, and Lancaster and the north, with a third main

Table I
Operating costs in 1949/50

Item	Average Annual Cost per Lamp (1949/50)				Total Annual Cost (1949/50)
	No. of Lamps	Energy Cost	Maintenance Cost	Total Cost	
		£	£	£	£
Electric	3,364	2.18	2.70	4.88	16,056
Gas	5,969	4.45	3.73	8.18	47,897
All lamps	9,333	3.62	3.36	6.98	63,953

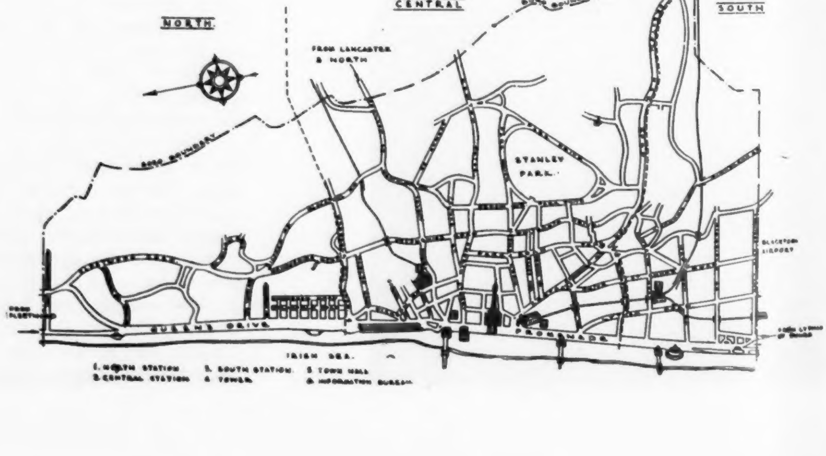


Fig. 1. Street plan of Blackpool.

artery, the north-south promenade route, conveying traffic from Lytham St. Annes, Fleetwood, etc., in addition to local and seasonal traffic. These main arteries are interconnected by a number of other main roads which prevent "bottle-necks" by filtering away the tremendous peaks of traffic which occur periodically. All these main roads were obvious priorities and, with the exception of the promenade, were phased for improvements according to the existing standard of lighting on each road.

Gas-lighted Roads (High-powered)

It was necessary to effect maximum financial and fuel saving as speedily as possible, and the second category, therefore, covered the change-over to electric lighting of all streets having gas lanterns consuming 10.8 cu. ft. per hour and above. Whilst this group tended to overlap the former in some degree it also took care of the many important secondary roads in the town, including bus routes and those pedestrian and vehicular traffic avenues which cater for the hotel, boarding-house and entertainment areas. Because of capital restrictions it was expedient to sub-divide this category into two, the first part being all-night lamps and the second part-night lamps.

General Improvements

This group covered those main roads and important secondary roads where the existing standard of lighting was not dangerously low, but where improvements were desirable. Whilst several thoroughfares, electrically lighted to reasonable pre-war standards, were included, this category primarily covered the seven-mile promenade route (considered in sections) and all roads in the immediate town centre.

Gas-lighted Roads (Remainder)

Owing to the large number of streets included in this category the town was divided into south, central and north areas (see Fig. 1) and priority given to the central area. Excepting back-streets, which because of the high cost of providing electricity services may have to be delayed, this group completes the change-over from gas to electric lighting.

Whilst priorities have generally followed the lines indicated, certain roads have, because of special circumstances or requirements, been included with another group. Several schemes have been in operation concurrently.

Programme

A number of technical and practical problems had to be investigated, amongst which the following examples are of interest.

As exposed metal-work on the sea coast is subject to a salt-laden atmosphere and blasting by blown sand, protection and painting is a costly recurring item. Mainly for this reason it was decided, generally, to use reinforced concrete columns, but, guided by previous experience, "spun and ground" columns were specified to ensure a hard weathering surface. In 1952, after works tests had proved satisfactory, pre-stressed concrete columns were introduced. Being lighter and of more slender design, these have since been used for all Group A and Group B installations, excepting the promenade (see later). The specification for lanterns for conventional Group A and Group B installations called for an asymmetrical "medium-angle" light distribution from bowl-type refractors. Metal parts had to be non-ferrous, and alloys

Table II
Programme of Relighting

Year	Scheme		Capital Expenditure £	No. of Lanterns: Group A	Special	Group B
Completed (January, 1956)						
1951–52	Change-over	Main Roads and small estate	22,353	245	—	256
1952–53	Change-over	Main and Secondary Roads	25,488	373	—	54
	Improvements	Main Roads				
1953–54*†	Change-over	Secondary and Side Roads (High-powered Gas—1st Phase)	31,000	—	—	770
1953–54	Change-over	Main Roads	12,000	165	—	—
1953–54	Improvements	Promenade (West Walk)	3,900	—	76	—
1954–55*	Change-over	Main Roads	12,000	141	22	—
1954–55	Change-over	Main and Secondary Roads	9,800	120	—	23
			116,541	1,044	98	1,103
In Hand (January, 1956)						
1955–56	Improvements	Promenade (3 miles of Carriageway)	35,500	—	560	—
1955–56	Change-over	Secondary and Side Roads (High-powered Gas—2nd Phase)	85,532	171	—	1,722
	Improvements	Main Roads				
1956–57	Change-over	Side Roads (Central Area)	77,110	4	260	1,566
	Improvements	Town Centre				
			314,683	1,219	918	4,391
Future						
	Change-over	Side Roads (North and South Areas)	65,000	—	—	1,670
	Improvements	Promenade (South)	13,500	—	200	—
	Improvements	Promenade (North)	11,000	40	80	—

* Almost complete.
† With the exception of this scheme all have been financed under loan sanctions.

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were chosen from test samples exposed on Blackpool Tower. Whilst, in a similar price range, several lanterns could satisfy these requirements, the final selection took into account maintenance characteristics.

In 1950 considerable thought was given to the choice of light source. Tungsten was eliminated because of its comparatively low luminous efficiency. The colour rendering of sodium was thought objectionable in a seaside resort, and fluorescent, though most desirable, was too costly for general use and was therefore reserved for special use for promenade and town centre lighting. Mercury-vapour was eventually selected as the most suitable light source for general lighting of Group A and Group B roads, although in the light of later developments it is possible that during the final stages more fluorescent lighting will be introduced for both Group A and Group B roads than was at first thought possible.

Consideration was also given to the problem of the most suitable switching arrangements and, in view of the cost of central and group control systems, it was decided to use solar dial synchronous time switches with individual electricity services to each standard, except in the few places, including the promenade, where separate cables permitted the easy installation of group control.

The programme has frequently had to be re-phased to accord with changes in the national and local finances, and the abbreviated schedule in Table II summarises the programme operated.

The average installation costs during the last five years (excluding the special promenade units referred to later) are summarised below, the costs varying from £60 (Group A) and £32 (Group B) in 1950 to £77 (Group A) and £39 (Group B) in 1955.

Detail	Installation Costs Group A £	Installation Costs Group B £
Column and bracket	22	11
Lantern	12.2	4.6
Auxiliary gear (excluding lamp)	7.3	2.9
Time switch	4.5	4.4
Erection, fitting, wiring, etc.	15	3.1
Service (N.W.E.B.)	12	11
	£73	£37

Additional to the main programme outlined, street lighting installations have been necessitated during the five years for new housing estates, spasmodic housing development and road improvements. The works completed, or in hand, at December 31, 1955, involved a capital expenditure of £48,000, covering 76 Group A lanterns and 1,052 Group B lanterns.

Promenade Scheme

Probably the most interesting individual lighting problem was the scheme for relighting the promenade. The full length of promenade carriageway covers the whole of Blackpool's sea front, a distance of nearly seven miles, but the principal section is the Gynn Square at the northern end to the Pleasure Beach at the southern end, with a popular promenade walk between the north and south piers.

The existing carriageway lighting consisted of canopies—relics of early twentieth-century lighting—fixed on tramway standards along the central island only, i.e., single side lighting, except for an occasional gas lamp on the east side. Some canopies had been fitted with dome refractors or well glasses and housed 500-watt or 750-watt tungsten filament lamps. A few 100-watt tungsten step lamps had been erected on the promenade walk but general lighting of the walk had not been attempted.

The first project was to light this promenade walk, a length of 1¾ miles. Any scheme had to harmonise with future proposals for the main carriageway lighting, and experiments had taken place, from 1952 onwards, in an endeavour to find the most suitable and effective light source and lantern—always having in mind that high-intensity lighting and decorative design were essential. Another important point was that the lighting chosen would have to be capable of speedy and cheap adaptation into colourful decorative lighting during the autumn season illuminations.

Umbrella type, horizontal tubular fluorescent lanterns were designed and prototypes constructed in the workshops; these did not prove acceptable and would have been expensive to manufacture. 1,000-watt mercury-fluorescent lamps were then tried, but these posed the problem of a 400-volt supply, and other difficulties connected with the alternative use for "illuminations" purposes. Cold-cathode lighting was considered, but again there would have been inherent difficulties at "illuminations time" with a unit for which the main advantage is a maintenance and a re-lamping period of several years. Finally tubular fluorescent lighting was chosen as having a suitable colour appearance for holiday crowds, flexibility of adaptation for "illuminations" purposes, high efficiency, etc. Unfortunately the well-known bracing breezes of Blackpool precluded the use of large-size lanterns and thereby ruled out the use of 5-ft. lamps.

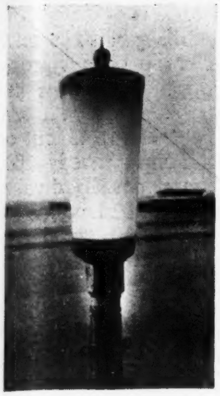
The "compromise" lantern adopted was a vertical type decorative unit suitable for up to eight 2 ft. 40-watt tubular fluorescent lamps and easily adaptable for four, six or eight lamps. All sheet metal parts had to be of copper and provision made for a special spigot box to house a 50-amp. "illuminations" connector block. The lanterns are used as post-top units for the West Walk and as double-arm units for the carriageway. A close-up of the lanterns and connector box is to be seen in Fig. 2 (post-top) and Fig. 3 (double-arm).

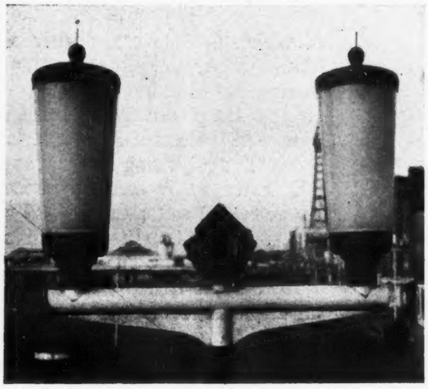
The columns for the West Walk are spun-concrete (21 ft. to lamp centre); the bottom of the base compartment is 4 ft. above ground to allow for back-wash (when the seas are breaking over the promenade), and there is accommodation for the fluorescent control gear and a 50-amp. miniature circuit breaker for an "illuminations" feeder. The column also has provision for eye-hooks for the attachment of festoon cables.

Seventy-six of these columns were erected in 1953 and 1954 at approximately 120-ft. spacing along this West Walk sea front, using eight lamps in each post-top lantern. Originally "daylight" lamps were fitted, but these have been replaced by the "new warm white" lamp. Conical colour screens are fitted during the autumn "illuminations" season.

The average cost per column was £49, excluding the distribution cabling installed for the "illuminations" load. The installation is shown in Fig. 4 (day) and Fig. 5 (night).

The second stage of the scheme was for lighting the





Figs. 2 and 3. Single- and double-arm post-top "Promenade" lanterns.

Figs. 4 and 5. Promenade West Walk by day and night.

main carriageway for approximately three miles from Gynn Square to the Pleasure Beach. Considerable thought was given to the best lighting lay-out. To avoid a forest of poles the centre island tramway poles had to be used. A staggered arrangement, while suitable for street lighting, had several disadvantages from an "illuminations" lay-out point of view. Opposite mounting offered better possibilities for festoon attachments, but with a maximum tramway pole spacing of 120 ft. and a decorative lantern of the type to be used, there was a danger of inefficient street lighting. Opposite mounting appeared, however, the best compromise, and steel columns matching the tramway poles on the centre island, with eye-hooks, were therefore erected (transverse loading at 23 ft. of 635 lb.) along the east side. Double-arm brackets are erected on these new columns and tramway poles (average mounting height 26 ft.). Eight "new warm white" lamps (the maximum number for each lantern) provide approximately 10,500 lumens; the installation gives about 13,000 useful lumens per 100 ft. of roadway with an iso-foot-candle distribution as shown in Fig. 6. (The maximum illumination recorded was 0.64 lm/ft^2 with an average of 0.4 lm/ft^2 and a minimum of 0.26 lm/ft^2.) Four, six or eight lamps are installed as required to provide the desired intensity. The average spacing is approximately 110 ft.

Simple colour screens are added for decorative lighting during the "illuminations," and the opposite-mounting eye-hook positions at two levels (19 ft. 6 in. and 22 ft.)

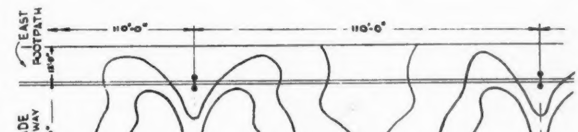


Fig. 6. Iso-foot-candle diagram for a typical section of the Promenade.

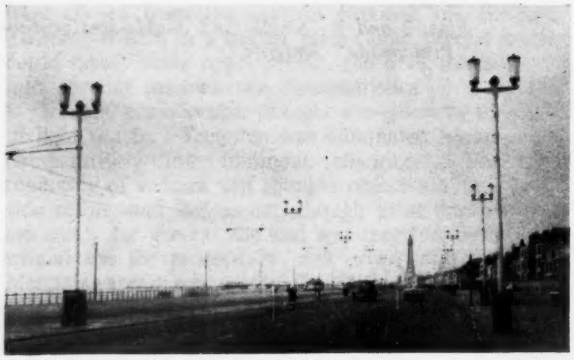


Fig. 7. Promenade carriageway by day.

make provision for effective festoon arrangements. At special positions along the promenade, in the vicinity of police traffic control points, the lanterns are furnished with green fluorescent lamps instead of colour screens. The efficient green lamps emphasise the presence of the white-coated police and add to the colour of the "illuminations."

Special base compartments are fitted at all positions with accommodation for fluorescent control gear and 50-amp. miniature circuit breakers for "illuminations" control. Wherever possible existing arc-mains (in many cases over 40 years old) have been used, reinforced by new cables and new feeder positions where required.

Another problem concerned the type of starter circuit to be used for these fluorescent lanterns. Whilst the preference was for instant start, switch-start units were finally installed because the supply voltage is at present only 200 volts, and the tapped transformers now purchased can be reset for a 240-volt supply when change-over takes place within the next few years.

The average cost per column, excluding "illuminations" distributors, was £100 for each of the 140 centre island lighting units fitted on existing tramway poles, and £150 for each of the 140 complete lighting units on the east side, an average cost of approximately £12,000 per mile. The annual running costs are approximately £1,540 per mile (£780 energy, £760 maintenance), with a total load of 130 kw.

The Future

In this article, which is in the nature of an interim report, an attempt has been made to summarise the progress to date.

At December 31, 1955, there were 10,556 street lamps, of which 6,526 were electric and 4,030 gas. The total luminous output of the lighting in operation was approximately 38 million lumens, averaging 5,200 lumens per electric lamp and 1,080 lumens per gas lamp. At that date 6,481 electric lamps were in operation (45 out of service), comprising 2,872 tungsten lamps, mostly 100-500 watts, 3,307 mercury-vapour lamps, equally divided between 400 watts and 80-125 watts, and 302 lanterns for 2-ft. 40-watt fluorescent lamps. The 4,030 gas lamps in operation were mostly of the 6.0 cu. ft. per hour type. 4,320 electric lamps were on part-night lighting and 2,206 on all-night; 3,172 gas lamps were on part-night lighting and 852 on all-night. Table III shows the estimated operating costs for 1955-56, and should be compared with the estimated present-day costs of the 1949-50 installation, £95,250 (£9.72 per lamp) referred to in the introduction to this article, bearing in mind the increased costs of labour, materials and energy during the last five years.

The programme in hand to cover the next 12 to 18 months is, after completing the promenade (carriageway) scheme, to install Group A fluorescent lighting, with lanterns similar to those used on the promenade, in the main streets of the town centre and to complete the change-over from gas to electricity in all important secondary roads throughout the town and all side roads in the central area.

After completion of this work it is expected that schemes will be considered for extending the promenade (carriageway) tubular fluorescent lighting from the Pleasure Beach to the southern boundary of the borough (approximately one mile), and from Gynn Square northwards to Bispham (approximately 1¼ miles), to replace the present tungsten lighting by mercury-vapour on the remaining promenade through route, and to continue the change-over from gas to electricity in the north and south areas of the town. This would be followed by replacing all tungsten Group B lighting by mercury-vapour and finally to change back-street gas lighting to electric.

Meanwhile, experiments are taking place to find a conventional-type lantern for Group B lighting suitable for 4, 40-watt (2 ft.) or 3, 30-watt (3 ft.) fluorescent lamps which would provide the higher intensity lighting required for many of the important side streets. Consideration could then be given to replacing mercury lighting by tubular fluorescent in certain streets.

Table III

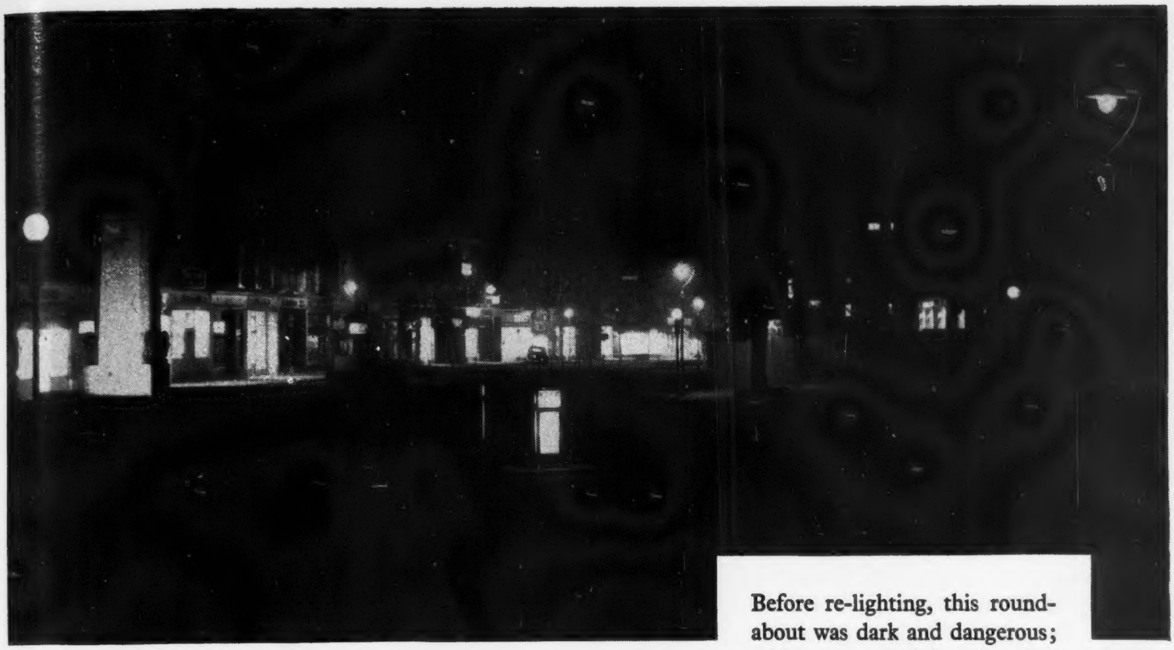
Estimated operating costs 1955/56

Item	Average Annual (Est.) Cost per Lamp (1955/56)				Total (Est.) Annual Cost (1955/56)
	No. of Lamps	Energy Cost	Mainten-ance Cost	Total Cost	
		£	£	£	£
Electric	6,481	2.96	2.53	5.49	35,575
Gas	4,030	4.01	4.06	8.07	32,575
All lamps	10,511	3.36	3.13	6.49	68,150

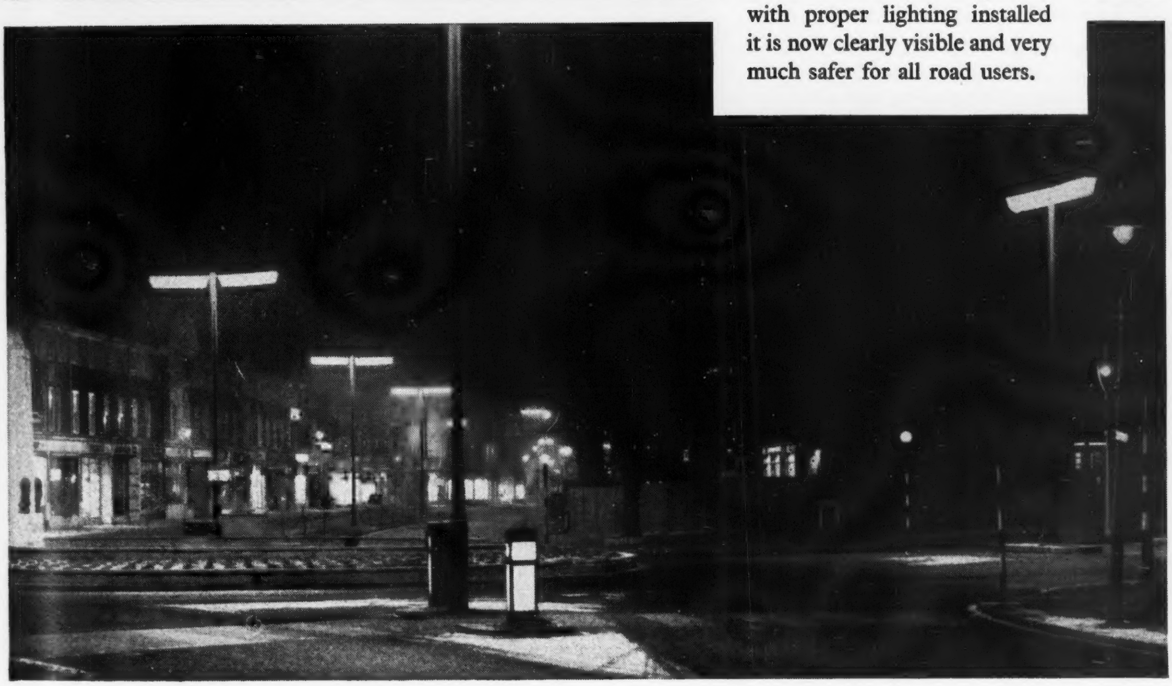
Acknowledgments

Acknowledgment is made to all manufacturers who have co-operated in the execution of these schemes, including The General Electric Co., Ltd. (lanterns, including the special "Blackpool" promenade lantern); The Stanton Ironworks Co., Ltd. (concrete columns); Stewart and Lloyds, Ltd. (steel poles for the promenade scheme); Sangamo Weston, Ltd.; The British Thomson-Houston Co., Ltd., and Philips Electrical, Ltd. (time switches and auxiliaries).

The author is indebted to the chairman and members of the Blackpool Corporation Highway Committee, his senior technical assistant, Mr. K. T. O. Cox, A.M.I.E.E., and all his staff of the Illuminations and Street Lighting Department.



Before re-lighting, this roundabout was dark and dangerous; with proper lighting installed it is now clearly visible and very much safer for all road users.



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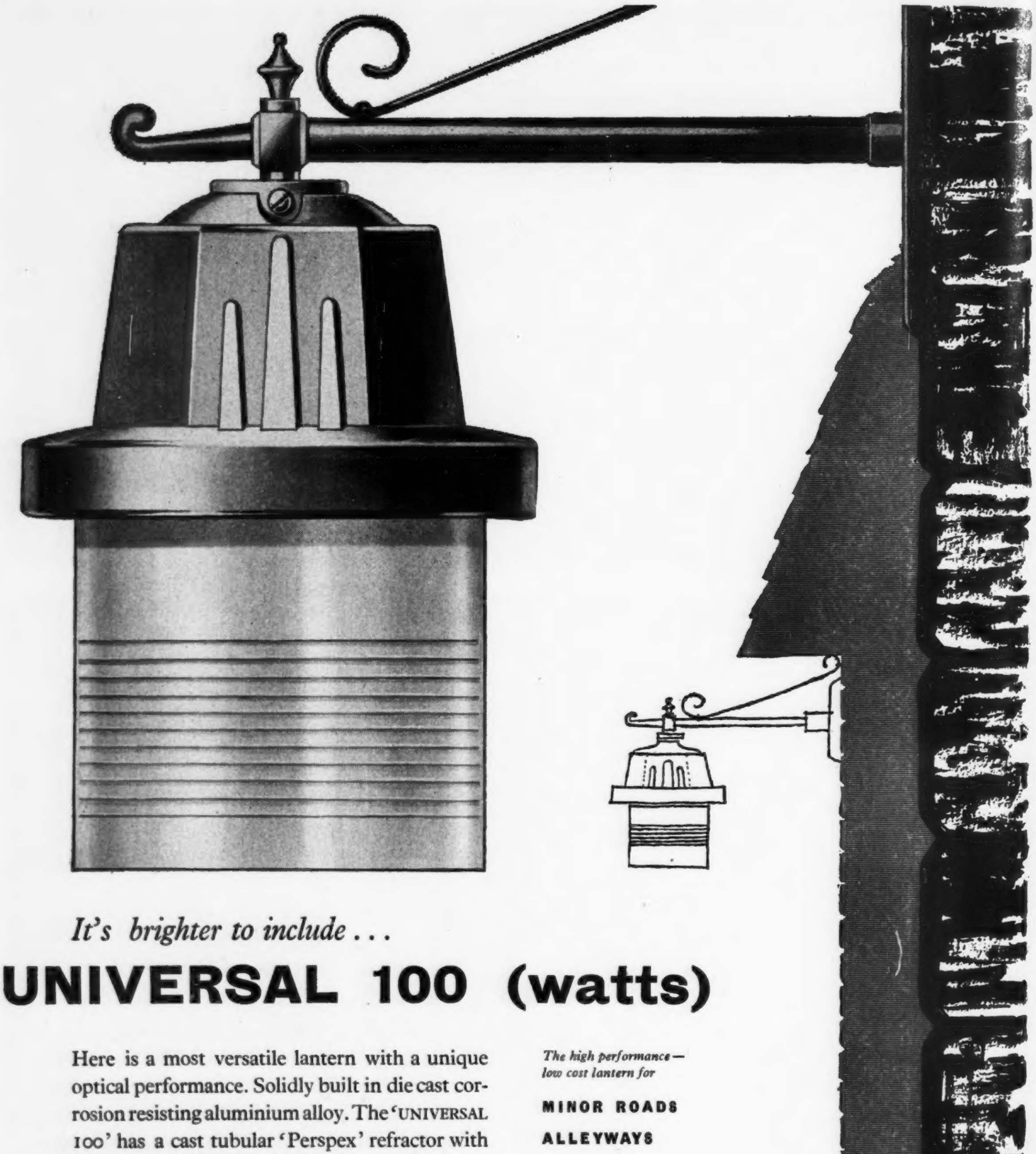

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An Installation for the Study of Brightness in Street Lighting

The following article describes an installation recently set up in Belgium to enable a systematic study of the factors influencing the quality of street lighting. The installation and associated test equipment are described and results to date are given.

By PAUL MASSART, Ing. A.I.Lg., A.I.M.*

(1) Introduction

The manufacturer of street lighting equipment has to produce a wide range of luminaires suitable not only for all modern light sources but also suitable for the wide variety of types of installation and conditions met in different parts of the world. As the cost of lighting is chiefly based on the price of electric current, wages and rates of interest, these factors being different in each country, the number of types of luminaires to be studied is constantly increasing, especially as regards the reflector systems incorporated in them. In addition most of the factors mentioned are constantly changing.

Confronted with this situation, the S.A. Eclairage Schréder of Ans-Liège designed and built laboratories and experimental installations of an original type with the following objects in view:—

(a) to establish positive criteria of lighting quality,
(b) to establish the photometric characteristics a luminaire must have in order to satisfy the requirements,
(c) to determine the forms of mirrors giving the photometric characteristics desired,
(d) to verify and adjust the mirrors thus designed,
(e) to carry out the necessary tests with complete certainty and with high precision,
(f) to carry them out on a large scale in a way which is not uneconomic as regards technicians' and experts' wages.

(1.1) Necessity for an installation for the study of brightness

It is clear that the first objective, i.e., a definition of criteria of lighting quality, could not be achieved by starting from classical data on horizontal or even vertical illumination. These data are unfortunately the only data available at present, but they are not at all characteristic of what the human eye sees when observing a lighted street or a road.

Although some workers have had some success in making an approximate estimate of the qualities of a lighting system starting from traditional factors, they must have detail of performance of the lamp and luminaire used and a good knowledge of the place to be illuminated. Moreover, they introduce, sometimes unconsciously, a safety factor sufficient to avoid errors and often they erect experimental installations on the road to be lighted. In short they may arrive empirically at good lighting systems but they scarcely succeed in obtaining lighting of the quality desired in the most economical manner.

We conclude that a study of the brightness of streets and roads, obstructions and luminaires and even traffic lights and signs, is an indispensable basis for the precise design of the apparatus and installations needed for the solution of a given problem.

(1.2) The data of the problem

We have to proceed simultaneously with critical visual examination and with objective measurements of brightness for most diverse installations, including luminaires with well-known distribution diagrams, installed in the greatest variety of ways on all common types of road surfaces in different conditions.

The eye being eventually the user, and therefore the judge, a subjective examination is still necessary to establish a starting point. Objective measurements will then give results freed from the human factor.

The interpretation of results still remains, of course, a matter of visual appreciation. But the purpose of the new test installation is to enable this to be dispensed with at a later stage by arriving at statistical conclusions derived from a very great number of tests.

In the absence of reliable extrapolation factors, tests must be made at full scale and on a sufficiently large area. To enable exterior installations to be checked, measuring devices must be autonomous.

(2) Details of the Installation

A test road, having a width equal to that of the widest highways, is bordered with posts supporting luminaires sufficient in number to give continuous lighting over a length covering critical observation distances for a driver proceeding at from 40 to 100 km./h., i.e., distances of about 50 to 200 metres.

Observations are made from standard positions fixed conventionally for an observer either at the side of the highway or in the centre of a circulation band 3 metres in width (minimum prescribed 2.50 m.—practical maximum 3.50 m.), his eye being 1.50 metres above the ground. The observations made include visual examination, brightness measurements of the ground and obstructions and the taking of photographs.

Several complementary installations serve to collate the photometric information on apparatus which has been tested and to calibrate measuring devices.

(*) Chief Engineer, Constructions Electriques Schréder, Ans-Liège, Belgium.

(2.1) The test road

This road, 150 m. by 12 m., is levelled with the utmost care. It covers an observation distance of 50 to 200 m. The surfacing may be changed periodically to meet the requirements of any particular investigation (Fig. 1). The initial surfacing was chosen to give characteristics midway between those of large slabs of concrete and continuous non-skid asphaltic carpet.

In addition, movable slabs, 3 m. by 0.50 m., of all other normal surfaces enable the behaviour of one with another at certain appropriate points to be related (Fig. 2).

(2.2) Posts

At present there are six fixed posts which, combined with three movable towers, enable all the installations desired to be set up. Test luminaires are fixed on carriages moved vertically by means of winches in order to obtain any mounting height from ground level to 12 m. (Fig. 4). Several types of bracket arms permit the fixing of any type of luminaire with an overhang of up to 3 m.

(2.3) The electronic brightness meter

As no suitable apparatus could be found on the market, an electronic brightness meter was designed and constructed by the company.

It meets the following special requirements :—

(1) objective measurement;
(2) a resolving power equal to that of the average human eye;
(3) a sensitivity sufficient to measure with fair precision the lowest levels met with in street lighting;
(4) a spectral curve corresponding to the spectral curve of luminous efficiency of the international average eye;
(5) the aiming system has a precision corresponding to the definition obtained;
(6) the aiming system enables the angular gradient of brightness to be measured directly;
(7) simultaneous visual examination of the zone measured and its immediate surroundings is obtained;
(8) the whole apparatus is autonomous and a single operator can adjust it and put it into service.

(2.3.1) *The optical system*

An achromatic doublet of 400 mm. focal length forms an image of the area to be measured and its immediate surroundings in the dividing cube (Fig. 5). This cube has a diagonal face, which is silvered except for a circle of 0.20 mm. diameter at the centre. Consequently the measured area covers an apparent angle of 3.5/10,000 in height and 5/10,000 in width.

The flux from the surface, being measured, passes through a series of colour-correcting filters and falls on a photomultiplier cell, type 1 P 21, mounted in a box with desiccator. An image of the surroundings of the measured surface is reflected vertically by the silvered face of the cube, goes through a rectangular prism and is examined through a microscope. The telescope thus formed has a magnifying power of 12 and a field of about 2.5 deg. The measured zone appears as a black oval spot in the centre of the image.

The above arrangement has the double advantage that it reduces to a minimum the energy losses in the measured beam, and it avoids errors due to parallax.

(2.3.2) *The electronic system*

The photomultiplier is supplied at 885 volts, i.e., 90 volts per dynode stage and 75 volts on the anode (Fig. 6). The anode is connected by a coaxial cable of high insulation and is earthed through a load resistance and a compensation resistance, both of which are simultaneously adjustable by the sensitivity selector. The dark current of the cell is compensated by an arrangement due to Plymale and Hansen[2] which has the advantage that only a single adjustment of the compensation current is necessary, whatever the sensitivity selected. A direct current vacuum tube voltmeter measures the potential across the load resistance. All supplies are regulated by stabilising valves.

The potentials of 1,500 volts and 250 volts necessary to

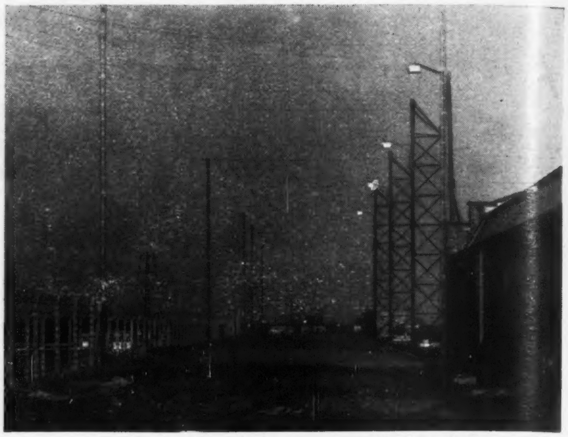


Fig. 1. Evening view of the test installation before a test, taken from the observation post.

Fig 2. View during tests on sodium lamp lanterns. The aiming target may be seen in the distance.

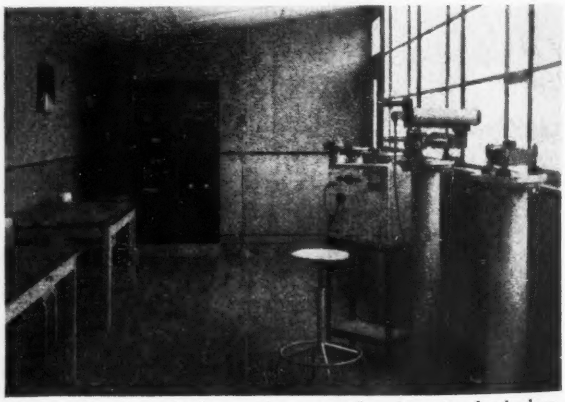


Fig. 3. Interior of observation post showing standard observation positions, brightness meter and central switchboard.

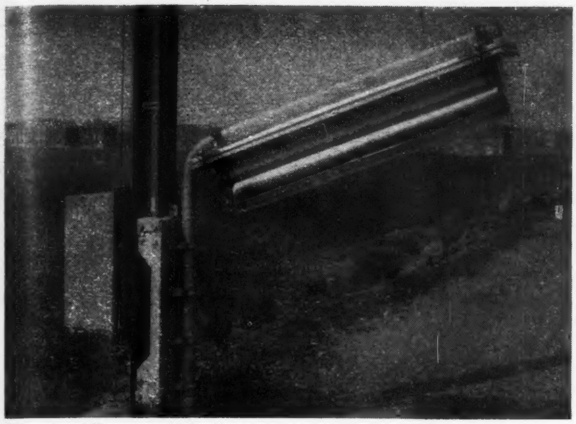


Fig. 4. The movable lantern carriage on pole.

supply the electronic part, as well as the gauge target and the lighting of the aiming system of the telescope described above, are all obtained from a 12-volt car battery.

(2.3.3) *The aiming system*

The aiming system depends on viewing a perspective image of the road (Fig. 7). For this purpose, the optical axis of the telescope is constrained to follow, at constant parallax, an aiming axis defined by the centres of two ball-and-socket joints, one fixed on the stand of the apparatus and the other constrained to move in a plane normal to the axis of the road. These joints, with integral kinematic constraints, permit an axial movement of the aiming axis but not its rotation. The aiming base, or distance between the centre of the fixed joint and the plane of movement of the mobile joint, is made equal to 300 mm., conventionally taken as the minimum reading distance. A micrometer cross-slide supports the movable joint, an aiming microscope with graticule and a lighting device.

A perspective graticule is fixed on the stand of the instrument. This graticule, obtained by photographing a drawing to a scale of 10 : 1 made with 0.1 mm. precision, takes into account the parallax between the optical axis and the aiming axis.

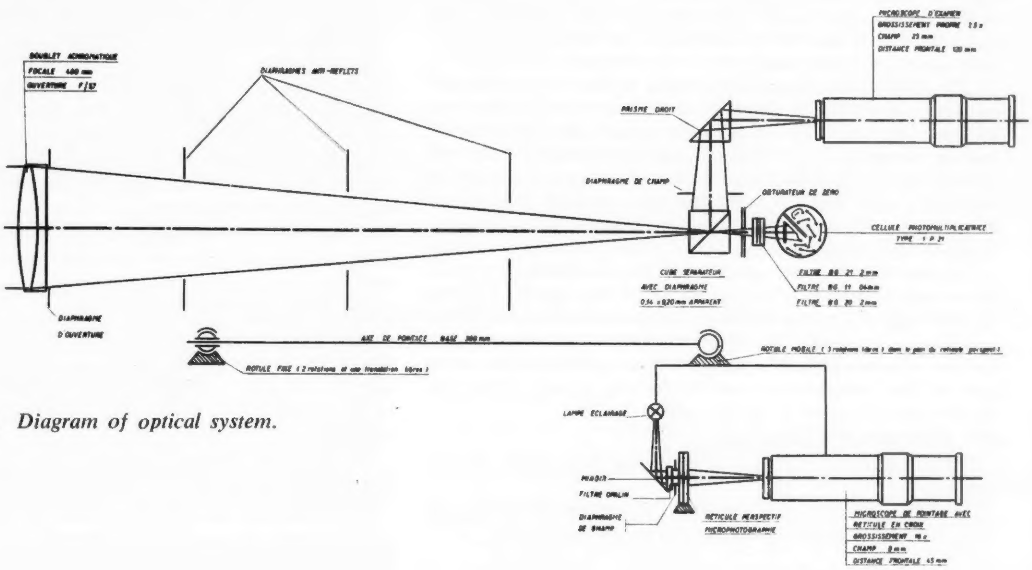


Fig. 5. Diagram of optical system.

The pitch of the micrometer screw is chosen so that 1/10 of a turn corresponds approximately to one unit of visual resolving power, fixed conventionally at 3/10,000.

The setting-up of the instrument is done with the help of a luminous target placed at a distance (100 to 200 m.) at 1.5 m. above the ground in the axis of the road.

To avoid any need for aiming when the brightness meter is employed on the test road, the three fulcra have balls resting in three ground vee-grooves mounted on solid bases and firmly fixed (Fig. 8).

(2.3.4) *Performance*

Sensitivity varies in 11 logarithmic steps from 0.1 to 10,000 cd/m^2, the end of the scale, the last six steps being intended for use when the apparatus serves as a brightness meter for light sources.

The spectral response curve has been checked by means of measurements of targets illuminated by incandescent sources, high pressure mercury vapour lamps, colour-corrected

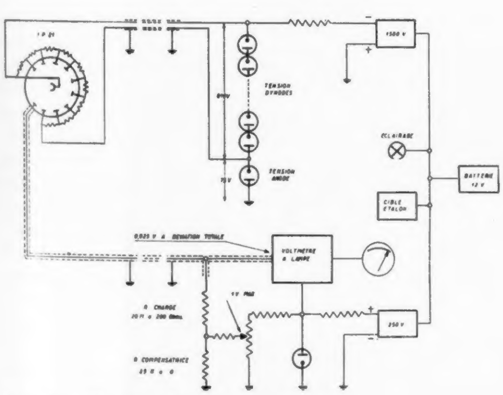


Fig. 6. Photomultiplier circuit.

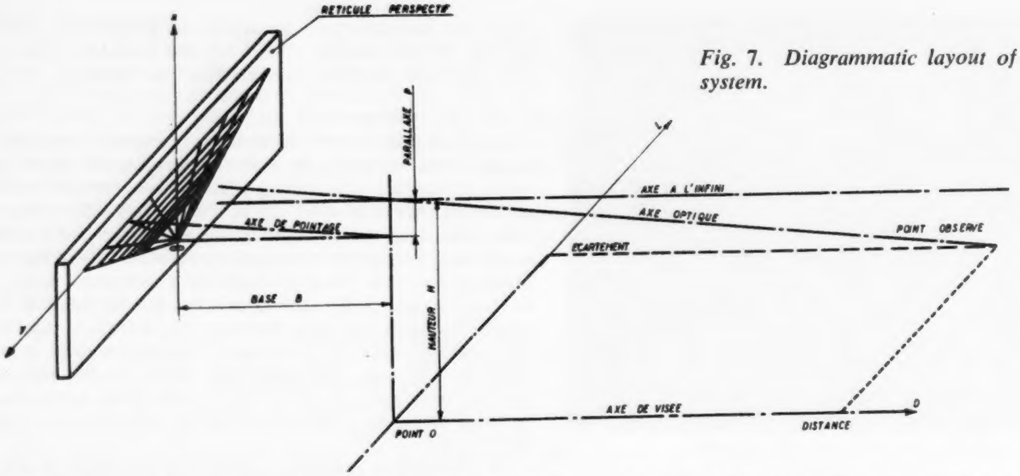


Fig. 7. Diagrammatic layout of aiming system.

h.p.m.v. lamps, low pressure fluorescent lamps and sodium vapour lamps, previously measured (a) with a Weston cell and Viscor filter and (b) subjectively. The differences found were less than 3 per cent.

The definition is practically equal to that of the human eye in the direction of observation and one and a half times as great laterally. The zero displacement after 10 minutes' heating is about 2 per cent. at all sensitivities. After 30 minutes it is practically zero. Noise at maximum sensitivity is about 1 per cent., i.e., 0.001cd/m^2. Taking account of these factors, the precision of the apparatus may be estimated at about 5 per cent. starting from a primary standard source.

All the optical parts needed for the construction of this instrument, including the graticule, were made by the Société Belge d'Optique et d'Instruments de Précision, Ghent.

We have to thank Mr. de Boer and Mr. Oostrijck of the Lichttechnische Laboratorium Philips at Eindhoven, who gave us the information required for the colour correction of the spectral curve S4 of the cell.

(2.4) Photometric photography

This apparatus has been constructed with three objects in view:—

(a) to keep a record of the tests carried out, for filing and to check results given by the brightness meter;

(b) to obtain, if possible, a recorded image which will enable measurements of brightness to be replaced by densitometric measurements;

(c) to obtain, if possible, a picture giving a real subjective impression of the lighting of the carriageway (an overall impression of the lighting, including both carriageway and luminaires, being unobtainable for known reasons).

The realisation of the second and third objectives is still in the experimental stage.

Contrary to an opinion generally held, the difficulties arise chiefly from the objective and not from the photographic emulsion.

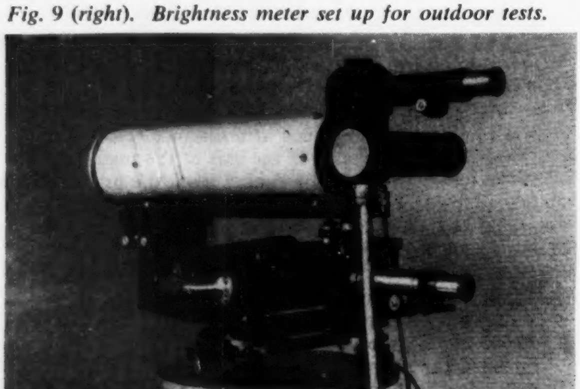
(2.4.1) *The camera*

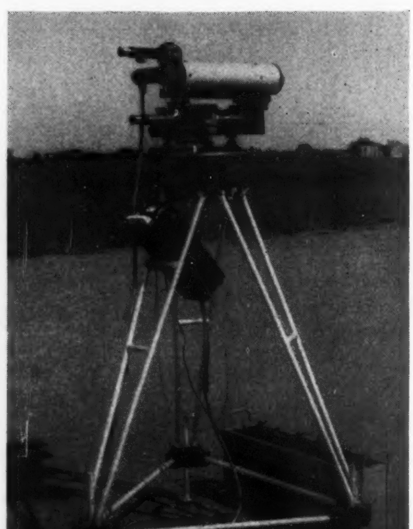
The camera used is a Linhof 13 x 18 cm. fitted with a Kodak Ektar 12-in. lens, f/6.3, corrected for a 300 mm. focal length. The focal length was chosen to be equal to the aiming base and to the minimum conventional reading distance.

In this way is obtained a negative which can be superposed on the perspective graticule for densitometric measure-

Fig. 8 (below). Brightness meter showing telescope, cell box and cross-slides with microscope containing graticule.

Fig. 9 (right). Brightness meter set up for outdoor tests.





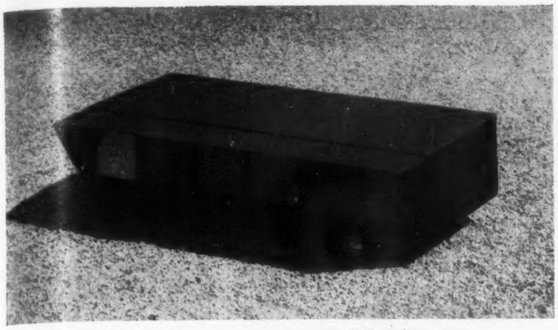


Fig. 10. Photographic target of graded brightnesses.

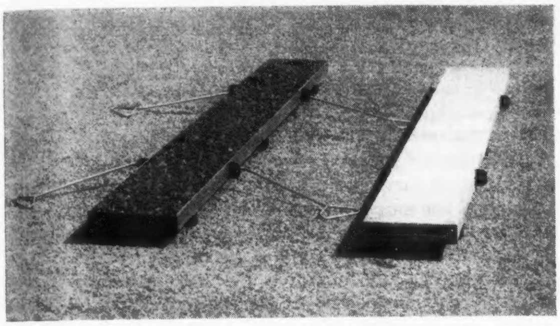


Fig. 11. Movable slabs of precoated chippings and concrete, over the natural covering of the road.

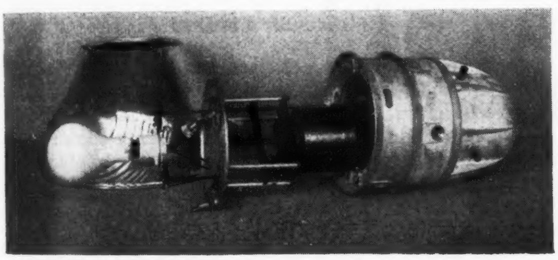


Fig. 12. Fitting with polished aluminium asymmetrical reflector for HPMV colour-corrected 125-watt lamp, with selsyn to adjust remotely the position of the lamp.

ments and a contact positive giving a faithful reproduction of the real perspective of the road. Moreover, the reduction of the angle covered by the objective reduces the loss of illumination due to the $\cos^4$ law and the marginal effect.

The apparatus is mounted on an adjusted base identical with that of the brightness meter and so is directly interchangeable with it. Negatives are taken on rapid panchromatic plates and developed in a fine grain developer.

The opening is fixed at f/11 by considerations of field depth and in order to reduce flare spots due to the sources. In addition to the exposure time deduced from readings of the brightness meter, two supplementary exposure times are used, respectively 2/3 and 1½ times this value.

In the field a target having six surfaces of graded brightness (0, 10—0, 16—0, 25—0, 40—0, 63—1 cd/m^2) is placed on the ground at a distance of 100 m. (Fig. 10.)

A preliminary densitometric examination of these surfaces enables the work to be checked in the linear part of the sensitometric curve.

At the moment a method of compensation for the $\cos^4$ reduction of light in the objective is being developed.

(2.5) Observation and control post

An observation post is situated at point 0 (Fig. 3); the base is perfectly level with the road. It is a closed room heated electrically by low temperature radiation, enabling work to proceed comfortably with all windows open, even in the depth of winter. Seven normal observation positions are set up each on an independent foundation. Measuring and supply devices, remote control and public address system, duplicated by a local telephone, are centralised at a switchboard.

(2.5.1) *Supplies*

Light sources are supplied at 220 volts A.C. regulated to 0.5 per cent.; their flux has been determined in the general photometric laboratory.

All accessories for discharge lamps are of semi-standard type, i.e., industrial models selected for their favourable characteristics.

Besides the regulated 220-volt supply, there are three-phase 220-volt circuits to supply general services, 110-volt A.C. and 24-volt D.C. circuits for the remote control.

(2.5.2) *Varying the flux from the lamps*

To study the effects of ageing of the sources and dirtying of luminaires, arrangements have been made to reduce the flux from the sources without changing either their light distribution curves or their colour. For this purpose a dimmer with two thyratrons in opposition can be inserted into the supply line of the luminaires. Its apparent power of 6 kVA is amply sufficient to cope with the demands for the best illuminated road. The flux is measured by the aid of a pilot lamp. A pilot photocell is connected to a measuring device directly graduated in percentages of the nominal value. A double trace cathode ray oscillograph enables a check to be maintained on the stability of the sources.

With this equipment it is possible to reduce the flux to 30 per cent. of its initial value for all discharge lamps, no special device being needed among the accessories.

(2.5.3) *Remote controls*

As this test installation is chiefly designed to study the construction of reflector systems for street lighting luminaires, there are devices which enable the operators to vary continuously and simultaneously from an operating post, certain elements in the construction or installation of the luminaires.

These systems depend on the use of selsyn transmitters and receivers. Sixteen independent operation circuits are available. In particular, it is possible to modify from a distance: the angle of tilt of the luminaires, the positions of the sources in the reflectors, and the positions of the reflectors in the luminaires.

Each problem necessitates the use of a special servo-motor (Fig. 12).

(2.6) Accessories

Some accessories used during the tests merit special mention. The aiming target, used also in the calibration of the brightness meter, is composed of an opalin panel illuminated from behind and having a brightness of 1 cd/m^2.

Contrast sighting-marks having a black and white surface enable contrasts to be determined by means of a double measurement with the brightness meter, one on the white surface and one on the neighbouring road. A support is used for outdoor tests (Fig. 9).

(3) Photometer Room

In order to draw constructive conclusions from brightness tests and to prepare these tests, we must know accurately the spatial distribution of luminous intensity.

For this purpose a photometer room of original design was built.

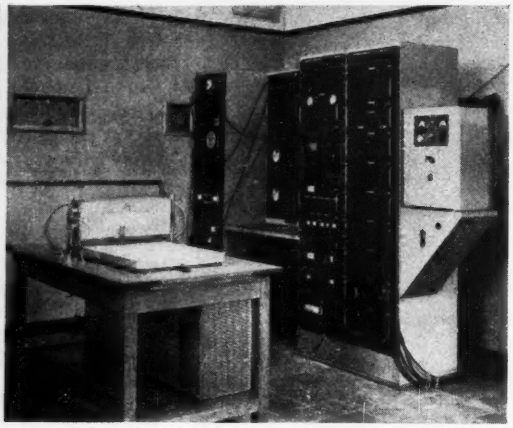


Fig. 13 (left). Interior of photometric room during a test.

Fig. 14 (right). Recorder and switchboard in the control room for the photometric bench.

(3.1) Principle of measurement

The photometry of luminaires with directed flux poses problems which make it impossible to use a classical photometer room with fixed equipment.

To obtain sufficient accuracy of measurement at distances less than 25 m. from apparatus of some size, it is necessary to make the measurements in the same way as they are used.

The measurement of intensity is therefore made with an objective photometer moving along the ground up to a distance of 25 m. from the vertical through the luminaire, which is mounted at utilisation height. For greater distances the inverse square law becomes applicable with reliability and in order to avoid making the room unnecessarily large and the deflection of the instrument too small, the height of the luminaire is reduced, the photometer being fixed at 25 m. Under these conditions, the whole of the lower hemisphere of a luminaire may be explored.

Measurements are made up to a height of 10 m.

The diagram of luminous intensity is drawn by a recorder at first in terms of the distance to the vertical through the luminaire, then in terms of the height of the luminaire.

Superposition of this diagram on various networks specially calculated for the purpose, gives directly the diagrams of intensity, horizontal illumination, vertical illumination, and radial illumination in terms of either the distance to the foot of the luminaire or the polar angle, and this for a number of vertical planes through the centre of the luminaire.

(3.2) Details of the measurements

The photometer room in its largest dimensions has a length of 30 m., a width of 11 m. and a height of 12 m. (Fig. 13).

The luminaire to be tested is fixed on a movable frame which may be placed in any position as regards height, rotation, or tilt. The photometer cell moves on a horizontal railway and, by means of a special cam placed between the rails, is automatically tilted so as always to face the luminaire. All operations are controlled centrally (Fig. 14).

Measurements are recorded by an automatic zero potential compensation bridge; the movement of the diagram on the table is controlled by the displacement of the cell and then of the frame. All movements are automatic and the recording of a continuous diagram in one plane takes 90 secs., including return to the initial position. Passage from one plane to another can be done automatically.

The complete photometry of the most complex luminaire requiring 36 planes of measurement is done in an hour and a half, including assembling and dismantling, the operator working less than an hour.

(3.3) Complementary equipment

To calibrate sources and measuring devices, the above installation is completed by (a) a photometer bench of 6 m. with lamps for measuring luminous intensity, (b) an integrating sphere, modified to the form of a regular dodecahedron for ease of construction, with a mean diameter of 1.50 m.

All illumination measurements are made either with Weston-Viscor luxmeters, in the case of measurements at normal incidence, or with GECO luxmeters corrected for incidence angle and of high sensitivity.

(4) Results Obtained

Since the installation described has been in service only since September, 1954, no conclusions of great importance can yet be given. So far we have studied only the brightness of roads and have hardly begun to study contrasts; we have not yet introduced factors due to the brightness of sources, borders, road warnings, electric signs, and so on. Naturally it is a long and exacting labour to go through the whole problem.

Some results, however, appear quite clearly and we have obtained scientific confirmation of some facts which have been noticed empirically in existing installations. For instance, the early tests have proved that the human eye is very exacting as regards uniformity of brightness. If an 80 per cent. uniformity of brightness gives perfect results in a particular case, at 50 per cent. the appearance of the highway is deplorable.

We have also established that the application of illumination similarity laws (reproduction to half scale, for instance) does not necessarily correspond to similarity of appearance, at least not with luminaires giving directed flux. For these dispersive luminaires we have succeeded in putting into figures the correlation which must exist between the ratio distance/height and the ratio of downward luminous intensity to maximum intensity in order to obtain lighting of satisfactory quality.

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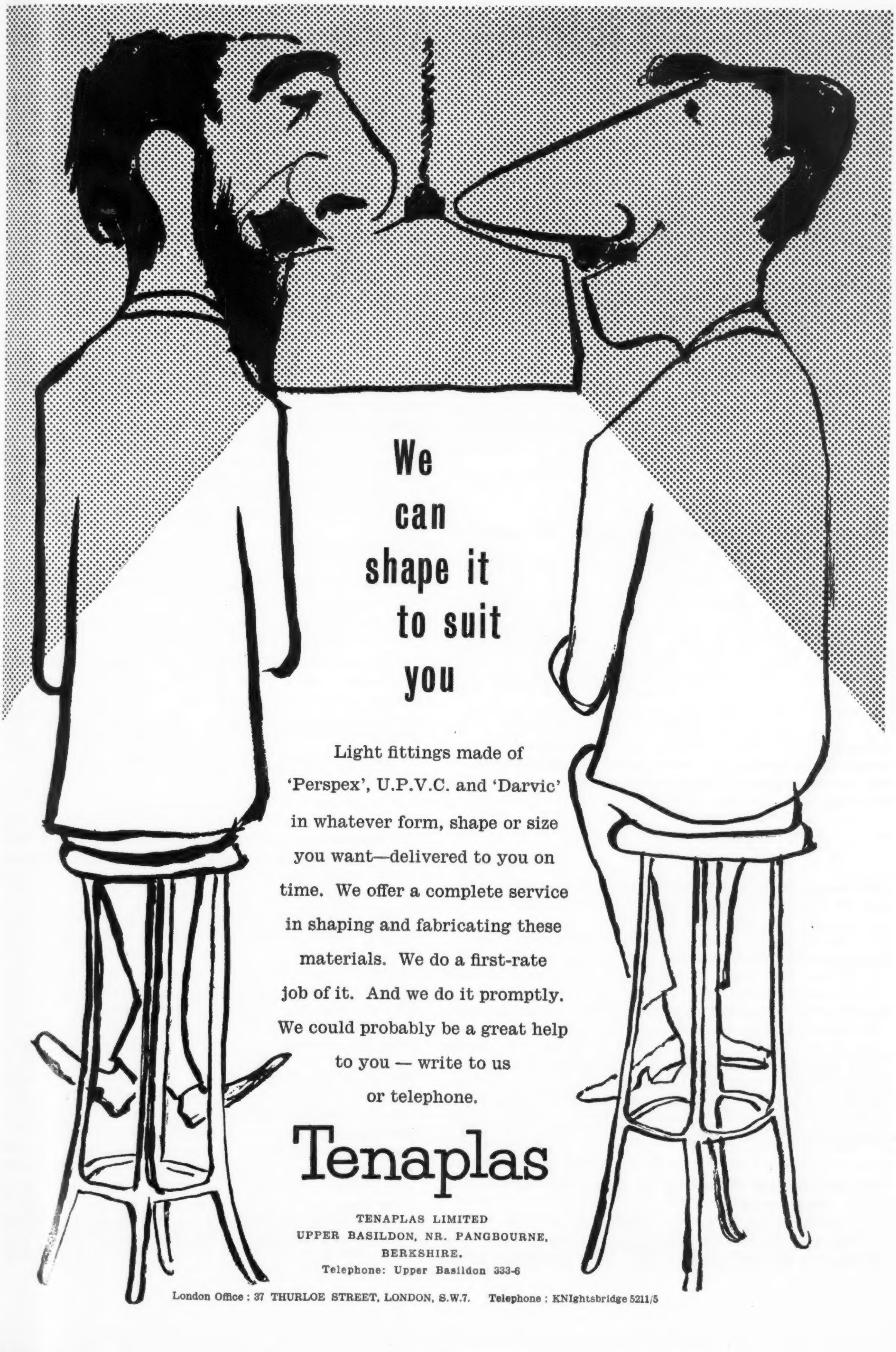
(4) P. Massart. Technical Note on the New Photometric Chamber of S. A. Eclairage Schréder, Ans-lez-Liège A.I.M. Sc. Bull. 1953, p. 705.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Lighting Abstracts

OPTICS AND PHOTOMETRY

311. The light stimulus. 612.84

S. Hesselgren, *Ljuskultur*, **28**, 25-27 (No. 2, 1956). *In Swedish.*

Visual perceptions are of three kinds, form-stimuli, colour-stimuli, and light-stimuli. The physical and psychological basis of high stimuli are discussed—intensity, direction, shadows, gloss and glare. R. G. H.

612.843.36

312. Dark adaptation as a function of the intensity and distribution of light across the preadaptation field.

C. A. Baker, A. Debons and D. F. Morris, *J. Opt. Soc. Amer.*, **46**, 401-404 (*June*, 1956).

Dark-adaptation was measured in three observers for durations of 30 minutes with these two variable parameters: preadapting luminance ranging from 0.8 to 2,500 mL, and the distribution of light across the visual field (38 deg.) from 0.8 to 100 per cent. The product (P) of the two was equated to six constants lying between 0.16 and 2,500. For constant values of P the dark-adaptation curves were alike.

R. A. W.

535.6

313. Apparatus for measuring the ageing and fading of samples under the action of light.

P. Schulz and K. F. Stubert, *Lichttechnik*, **8**, 254-257 (June, 1956). *In German.*

Describes a fastness-to-light test in which samples are compared with a series of eight specimens of dyed wool of progressively greater fastness. If, for example, when a test sample just shows the first signs of fading, specimens 4 to 8 are unaltered, the fastness of the test sample is rated at 3. The sources used are four xenon lamps, each giving 4,500 lumens, and both lamps and samples are mounted inside a box which acts as an integrator, the illumination of the samples being about 1,900 lm/ft^2. The temperature and humidity inside the box are carefully regulated during the test as these have a considerable influence on the results obtained. J. W. T. W.

LAMPS AND FITTINGS

621.327.43

314. Color rendition with fluorescent sources of illumination.

H. Helson, D. B. Judd and M. Wilson, *Illum. Engng.*, **51**, 329-346 (*April*, 1956).

Five observers trained in the assessment of colour appearance according to a modified Munsell scale were used to appraise the colour appearance of 130 Munsell patches viewed under Macbeth daylight and under fluorescent lamps having colour temperatures of 3,500, 4,500 and 6,500 deg. K, the observers being adapted to the illuminant in each case. The shifts in the hue, lightness and saturation with change from daylight to illuminants of progressively lower colour temperature are reported. Comparisons are made with predictions of colour appearance derived from a formula proposed initially for coloured objects viewed under incandescent filament lighting. P. P.

621.329

315. Investigation of heating of ceiling-inset incandescent lamp fittings.

Ljuskultur, **28**, 41-42 (No. 2, 1956). *In Swedish.*

The new fashion for ceiling-inset fittings has given rise to fears of an additional fire risk, since ventilation of the fitting is not likely to be so effective as with a pendant fitting. A systematic study of the problem has been undertaken by the Electrical Inspectorate in Helsinki. A table of measurements is given. A recommendation is that a fitting should be so designed that a lamp bigger than the one for which it was intended cannot be fitted in. R. G. H.

535.24 : 535.3 : 535.39 : 535.6

316. The measurement of the luminous flux of light sources: choice and properties of white coatings for photometric integrators.

J. Terrien, *Bull. Soc. Franç. Elect.*, *7th Series*, **6**, 307-312 (*May*, 1956). *In French.*

The conditions governing the optimum reflection factor for sphere coatings are discussed; the best general value is 0.85-0.9. For homochromatic photometry a value of 0.95 may be better, but for the comparison of sources of markedly different colour, a lower value of 0.85 max. is to be preferred. A recipe is given for a finishing coat consisting of zinc oxide or barium sulphate water and a gum, for which the most satisfactory is carboxymethyl-cellulose. A sensitive method of measuring the properties of paints is described, in which they are applied to the interior of a small sphere. The new paint gives markedly better results than previous paints. J. M. W.

621.327.43

317. First examples of new resonance lamps at very low voltage.

M. Laporte, *Bull. Soc. Franç. Elect.*, *7th Series*, **6**, 298-306 (*May*, 1956). *In French.*

First laboratory models have been made of small fluorescent lamps, having bulbs of fairly conventional shape and fed and supported from one end. They require no starting device nor ballast, and operate by resonance radiation of mercury in conditions based upon the hot cathode diode mercury vapour rectifier or "phanotron." No information is yet available upon efficiency or life or maintenance.

J. M. W.

628.93

318. Meaning of the term efficiency when applied to fittings for lamps whose flux output changes with temperature.

O. Reeb and E. Dittrich, *Lichttechnik*, **8**, 155-159 (*April*, 1956). *In German.*

The efficiency of a fitting is simply defined as the ratio of its light output to that given by the bare lamp, but with fluorescent lamps this cannot be measured directly because the lamp output changes when the lamp is in the fitting, owing to the rise of temperature. The authors propose that the term efficiency should continue to be used in the sense above defined and that a correction should be applied to the lamp flux measured in the open to allow for the change of output when the lamp is in the fitting. They point out that two other quantities are also of interest to the lighting engineer. One of these is the ratio of the flux from the fitting to that from the lamp when the ambient temperature is that specified by the lamp maker. The other is the ratio of the flux from the fitting to that from the lamp in the open, when the ambient is the same in both cases. The authors also consider the more complicated case of a fitting with more than one lamp and they point out that the light distribution from such a fitting may be affected by differences between the temperatures of the several lamps.

J. W. T. W.

LIGHTING

319. Report of Street, Tree and Utility Conference. 628.971.6

W. H. EDMAN, *Illum. Engng.*, **51**, 359-367 (*May*, 1956).

After reviewing the contributions to a Street, Tree and Utility Conference held in Cleveland in 1955, some aspects of the influence of street tree planting on street luminance layout are considered in detail. Graphs, diagrams and tables show how the mounting height and spacing of luminaires are related to the sizes of different types of tree and some indication is given of the economics of tree lopping. P. P.

628.93

320. A design procedure for luminous ceiling lighting.

J. N. ROBERTSON and G. E. HUTCHCROFT, *Illum. Engng.*, **51**, 349-354 (*May*, 1956).

Surface luminances and working plane illumination for lighting installations using luminous ceilings are calculated by a new procedure which uses data already published. Formulae have been developed for the efficiency of the luminous ceiling system, for the effective reflectance of the ceiling surface and for the absorption of the diffusing material. Good agreement is found between calculated values of luminance and illumination and corresponding values measured in actual installations. P. P.

628.972

321. 840 cycles at 400 volts lights new office building.

B. C. COOPER, *Electrical Construction and Maintenance*, **55**, 80-85 (*April*, 1956).

Describes a new high-frequency fluorescent lighting installation in an office building, in which a 440-volt three-phase 60-cycle supply is converted to 400-volt 840-cycle three-phase six-wire supply by a specially developed motor converter. The modular suspended luminous ceiling, giving 100 lm/ft^2, is described and the advantages derived from the use of high frequency for the lighting are indicated.

W. R.

628.971.6

322. Points of view on the development of street and road lighting in Stockholm.

L. BLOCK, *Ljuskultur*, **28**, 45-51 (*No.* 2, 1956). *In Swedish.*

A proposal has been made to draw up a general plan for the relighting of all the streets in Stockholm. The article reviews the development of modern street lighting in the city, comparing the present general standards of 100-watt or 150-watt filament units with more modern sodium and mercury units. Sodium is preferred by car-drivers, who then use their parking lights only. Glare and adaptation are discussed, and the need for reasonable colour-rendering in built-up areas stressed. R. G. H.

628.92

323. Experiments with sunlight and daylight in the U.S.A.

G. PLEIJEL and I. KARLEN, *Byggmastaren*, **35**, 18-19 (*B*3, 1956). *In Swedish.*

A report of recent work on daylighting research in the U.S.A., and on studies of the use of solar energy for heating. Attention is drawn to the increasing use of supplementary fluorescent lighting in American factories, at levels of 50 to 100, and even 500 lm/ft^2. R. G. H.

324. Cable factory in Sundbyberg. 628.972

O. BULL, *Byggmastaren*, **35**, 42-43 (*A*2, 1956). *In Swedish.*

A factory has been built in an industrial suburb of Stockholm, in which the daylighting is achieved entirely through glass blocks. Top-lighting is provided by spans of glass blocks 4 m. wide by 50 m. long, one for each 16.5-m. section of the building. A continuous band of glass blocks in the side walls, from 1.5 m. to 4,5 m. from the floor, provides side lighting. The four lowest rows of blocks are transparent, and the others are directional. R. G. H.

621.329

325. Visual comfort and cost analysis for production lighting.

G. J. TAYLOR and R. D. BRADLEY, *Illum. Engng.*, **51**, 293-301 (*April*, 1956).

Calculations have been made of the comparative costs and resultant degrees of glare for industrial lighting installations using 15 different trough-type fluorescent fittings grouped according to kind of light distribution (*viz.*, no upward light; 5-15 per cent. upward light; 20-30 per cent. upward light). First costs are in favour of the fittings giving 5-15 per cent. upward light rather than those giving no upward light. Comfort ratings using the Harrison-Meaker Glare Factor System indicate the advantage of having some upward light. Comments are made on suitable room finishes and on maintenance, and some data are given relating to a depreciation test on ventilated and unventilated reflectors.

P. P.

326. Measured utilization data for luminous ceilings. 628.93

A. H. RUSSELL and R. D. CHURCHILL, *Illum. Engng.*, **51**, 309-319 (*April*, 1956).

A 12½-ft. square test room has been used to measure the coefficients of utilisation of luminous ceilings comprising three types of plastic diffuser backed by a 14-in.-deep cavity containing 40-watt fluorescent lamps at 15-in. centres. The coefficients are tabulated for a number of values of room ratio and of cavity, wall and floor reflectances. Comparisons are made with values of the coefficient calculated from equations for cavity efficiency and room utilisation. Reasons for the slight discrepancies are offered. P. P.

327. The case for sloping windows. 628.97

K. C. WELCH, *Illum. Engng.*, **51**, 320-323 (*April*, 1956).

Photographs of a mock-up window display showing the superimposed reflections of two test objects are used to illustrate the luminance relationships between objects viewed directly and by reflection, which determine the degree of veiling glare caused by shop-window reflections. Daytime window illuminations of the order of 500-1,000 lm/ft^2 are required to offset the veiling effect produced by reflections of high surrounding luminances from the street and sky. Shop windows sloping inwards at the bottom so as to reflect the relatively low luminance of a shaded pavement have proved effective in eliminating unwanted reflections. The technique has also been employed to reduce veiling glare on picture windows in dwellings. P. P.

328. Calculating coefficients of utilization. 628.93

Illum. Engng., **51**, 385-417 (*May*, 1956).

Coefficients of utilisation currently used in illumination calculations are based on tests made by Harrison and Anderson in the period 1915 to 1920. Since that time there have been extensive changes in the flux distributions from luminaires, in the number and distribution of luminaires in an installation and in the photometric techniques employed. To meet these changes the Lighting Design Practice Committee of the American I.E.S. has recommended that new coefficients of utilisation should be evaluated using the Zonal-Factor Interflectance Method of Jones and Neidhart (1953). Work sheets, tables and graphs are provided to enable a step-by-step method of calculation to be carried out. P. P.


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Street Lighting in Madrid

Avenida de José Antonio: 1,000-watt colour-corrected mercury lamps.

The February, 1955, issue of *Light and Lighting* included an account of the progress made up to that time in the relighting of the city of Madrid. The author of that article, Juan Lillo, Director of the Madrid Lighting Department, has supplied the following details on more recent developments.

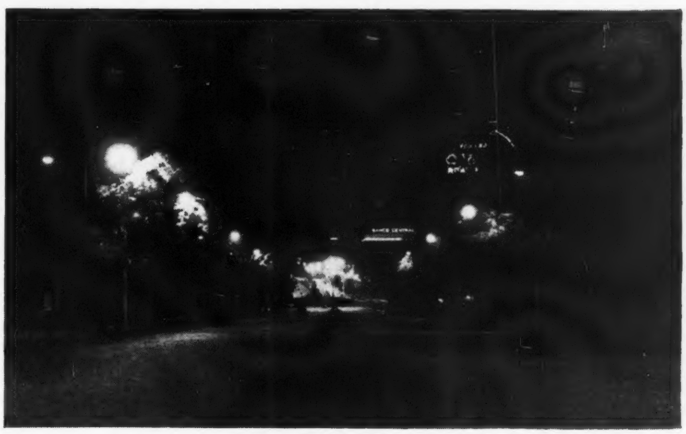
During the past four years the lighting of some hundreds of kilometres of streets has been modernised, fluorescent lighting being widely used. When the colour-corrected mercury lamps became available these were also used on a large scale as in the Avenida de la Castellana, one of the principal roads in the city, which is lit throughout its length of 5½ km. with 400-watt colour-corrected lamps.

Last year the 1,000-watt (55,000 lumen) colour-corrected mercury lamp became available and was used to relight the Plaza de Cibeles and part of the Calle de Alcala to an average illumination of 3 lm/ft^2. A few weeks ago similar lamps were used to relight the Avenida de José Antonio, an important business street off the Calle de Alcala.

In its task of improving the street lighting of the city the Madrid authorities have the enthusiastic and financial support of business people and industrialists who are convinced that a well-lit street furthers publicity and stimulates the sale of their products by attracting the public to their establishments. Such is the case with the Avenida de José Antonio, where the cost of the new lighting has been met entirely by the occupiers of shops and business premises in the street through their trade organisation.

It is not, however, only the main roads that are receiving attention. The older parts of the city abound with little squares and narrow streets. Here the old-type gas lanterns have been retained but have been converted to use the smaller wattage colour-corrected lamps. The glass of the lanterns often has a matt finish so that though the lighting is greatly improved the means of attaining it are not obvious and the character of these older parts of the city is retained.

Calle de Alcala between Avenida de José Antonio and the Plaza de Cibeles: double arm columns carrying 1,000-watt (road side) and 250-watt (footpath side) c.-c. mercury lamps. Average illumination 3 lm/ft^2.



Calle de Alcala between the Plaza Independencia and the Plaza de Cibeles: double arm columns carrying 400-watt (road side) and 250-watt (footpath side) c.-c. mercury lamps. The Plaza de Cibeles (middle distance) and the section of the Calle de Alcala beyond are lit with 1,000-watt c.-c. mercury lamps.

The Lighting of the new Saint Cloud Bridge

By L. GAYMARD*

In considering the lighting of a bridge the first idea which comes to mind is to consider the work as part of the road that crosses it, and thus to prolong on the bridge the kind of lighting used for the road. Such a solution requires the erection of columns on the bridge, except when its total length does not exceed 100 to 120 feet. The problem of lighting a short bridge is, of course, an easy one, the only precaution to take being to increase the light output of the lanterns at each end of the bridge, especially when the width of the carriageway is smaller on the bridge than on the approaches.

Lighting a long bridge is more difficult. When the bridge is made of several short arches, the erection of a pole just above each pier can be a good solution (Fig. 1), provided that posts, brackets and lanterns are used which have a sober silhouette, matching the general line of the work. If the arches are much wider than the normal (or possible) spacing of columns, additional posts may be put between the piers (Fig. 2). We found, however, that such a disposition is bad from the aesthetic point of view, and we tried something else.

Since great progress has been made in bridge engineering during recent years, it seems more and more regrettable to spoil the audacious and pure silhouette of a beautiful span by poles erected at regular intervals. A lot of research has been done in France in recent years to solve this problem. A well-known installation before World War II was that of the Pont du Carrousel in Paris, in front of the Louvre. This wide bridge is lighted by four gigantic columns, 47 feet high, by day, and extending automatically to 70 feet each evening on the operation of the remote control switching-on of the public lighting of Paris.† This device, rather satisfactory from the aesthetic point of view, has proved very expensive, both in initial cost and in maintenance,‡ and for these reasons will presumably not be reproduced anywhere.

The Saint Cloud bridge is the route through which all

Fig. 1. Pont Neuf, Paris.

Fig. 2. Pont de Poissy, Paris.

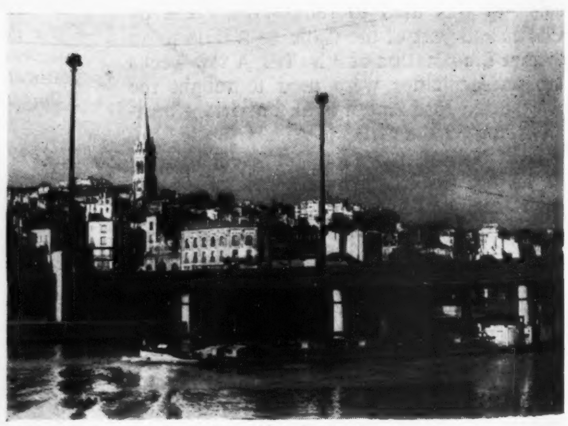


Fig. 3. Pont de Saint Cloud, Paris.

the traffic from the western turnpike crosses the Seine to join Paris and its suburbs. The bridge is 600 feet long and 117 feet wide between the parapets. Such a width was considered as fully adequate when the bridge was built a few years ago; but it is now hardly wide enough in spring, summer and autumn to cope with the enormous traffic coming in and out of Paris, especially during weekends. (" Traficounters " frequently register a flow of more than 5,000 vehicles per hour in one direction alone. Since

* Chief Engineer Street Lighting, Electricité de France, Paris.

† L. Gaymard: Public Lighting in France and in England at the present time. Transactions Illum. Eng. Soc. (London), **14**, No. 8, 1949.

‡ Not only do the lanterns' cleaning and relamping require an abnormally high and costly tower-wagon, but it happens that a sudden and severe frost, coming after snow, blocks the columns during the night in the upper position, spoiling the material, and making a very costly repair necessary.

Fig. 4. *Pont de Saint Cloud.*

Fig. 5. Pont de Saint Cloud, dry weather. (The lights seen in this picture and in the one below are on the far side of the bridge.)

Fig. 6. Pont de Saint Cloud, wet weather.

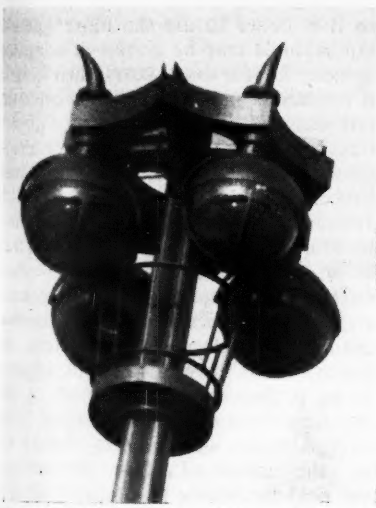


Fig. 7. The lanterns and the maintenance platform.

more than 300 *new* cars are registered daily in Paris itself, it can be anticipated that the 1956 summer figures will be still denser.)

This long and wide bridge and its entrances are lighted (Figs. 3 and 4) by four gigantic steel poles carrying colour-corrected mercury lamp lanterns. The total height of each pole above the Seine banks is 140 feet, and the height of the lanterns above the pavements is 120 feet. At the top of each column is a four-horn head (Fig. 4) from which four big spheres are hung. These spheres are made of iron coated with copper, with the lower half of opal glass. Each sphere is provided with a special Holophane optic, and contains two 400-watt colour-corrected mercury lamps, each giving about 17,000 lumens. The total initial luminous output from each column is thus about 136,000 lumens. The maximum intensity of each optic is directed towards the central area of the bridge: the maximum illumination is 1 lm/ft^2, the minimum 0.3 lm/ft^2. The luminance of the carriageway from the driver's eye level is reasonably even on dry nights (Fig. 5), thus providing a sufficient visibility of obstacles. Due to the height of the lanterns the reduction of revealing power under wet road conditions is well within admissible limits (Fig. 6).

The maintenance, cleaning and relamping of the 16 lanterns, and the upkeep of the pulleys and cables are made by workmen standing on a ring-shaped platform just below the top of each column (Fig. 7). A small lift operated by an electric winch located at the bottom of the pole takes the maintenance men up to the top. The ascension or descent of the lift takes 10 minutes.

Taking into account the auxiliary gear, to start and stabilise the discharge and to improve the power factor up to 0.8, the total electric power is 17 kw., that is 15 watts per square foot of lighted surface; the average illumination level is, of course, lower than it would be with an installation of numerous poles of average height. In addition to that, it must be recognised that the initial cost, and the annual maintenance cost, are higher than with an ordinary installation. This is the price we pay for æsthetics.

Modern English Usage for the Lighting Engineer

"Precision is a virtue in technical writing." If those who write on lighting matters, whether as authors of papers or articles or simply in the course of their daily work, are lacking in virtue in this respect it is only the state of the lighting vocabulary that is to blame. It is hoped, however, that this article will help readers to understand the language of their calling and to use it effectively.

By J. W. T. WALSH,
O.B.E., D.Sc., M.I.E.E., F.I.E.S.

apostilb. See FOOT-LAMBERT.

apparent brightness. See EQUIVALENT LUMINANCE.

azimuth. This is an astronomical term used in describing the position of a point in the heavens. It is the angle between the meridian and a vertical plane through the point. The term has been much used, in connection with light distribution diagrams, to denote the angle between any vertical plane through a lighting fitting and some specified vertical plane taken as the plane of reference. In particular, for street lanterns the reference plane is usually that intended to be parallel to the centre line of the street (marked 0 deg. on the isocandela diagram) and the angles marked on the sinusoidal lines of an isocandela diagram are often referred to as *angles of azimuth*. It has been urged that this use of the term to denote an angle without reference to any particular compass direction is not legitimate and may be confusing to those accustomed to the stricter usage. The alternative suggested is *bearing*, so that, for instance, a particular plane would be described as having a bearing of *n* deg. on the road side and the angles on the isocandela diagram which were referred to above would be called bearings. Other possible alternatives are *horizontal angle* and *angle on plan*, but neither of these is really satisfactory. It is worth noting that the OED* admits the more general use.

bearing. See AZIMUTH.

brightness. For many years lighting engineers worked quite happily with this word to denote the attribute of a body emitting or reflecting light, without bothering whether it referred to the physical property of the body or to the sensation which it produced in the eye of the beholder. However, the precisionists found it necessary to make the distinction, and the word *luminance* was coined to denote the physical quantity measurable in terms of the luminous intensity per unit area. The word to be adopted for the subjective correlate was for some time in debate, but *luminosity* was finally adopted in spite of the fact that, unlike luminance, it was already in general use with a different meaning.

Precision is a virtue in technical writing—we have it on very high authority that "writing [maketh] an exact man"—but unfortunately luminance and luminosity have divided the lighting world into three sections, viz. (1) those who know what the words mean and display their knowledge by using them at every opportunity, (2) those who are not sure and so avoid using them for fear of blundering, and (3) those who know but are also aware that there are occasions when it is better to use the more general word *brightness*. An example may be given. A common form of visual photometer has for many years been known as an "equality of brightness photometer," but now the would-be purists have changed this to "luminosity photometer" (BSI) regardless of the fact that, while the criterion is necessarily equality of the sensation, what is desired is equality of luminance. Thus the instrument might, with equal justification, be termed a "luminance photometer," but why change the established name at all? The chief function of the word *brightness* here is to parallel *contrast* and *flicker*. *Luminance* and *luminosity* should be used where it is necessary to indicate clearly which of the two aspects of brightness is being referred to, or where the meaning is restricted to one of them alone. For general use *brightness* is to be preferred, as it has been in the following examples, taken from the I.E.S. Code: "the immediate surroundings to the light sources should be so brightened that the transition from source-area luminance to general field luminance is gradual and not abrupt, thus avoiding glaring brightness contrasts" and "the ratio of local to field brightness will usually be satisfactory if the designed value of general illumination. . . ."

candela. Pl. -as. This word is pure Latin and should be pronounced with the accent on the second syllable. Whether this syllable is called *dee* or *day* depends on the habit of the speaker as regards the pronunciation of Latin, but the *day* form seems to have the support of the majority. The substitution of this word for *candle* was occasioned by the desire to have an international name for the unit of luminous intensity. It represents a narrow escape (for those speaking English) from the adoption of the French proper name Bouguer (pron. Boogair). Its use in the compound *foot-candela* is deprecated. The foot-candle is not an international unit; its use is confined to English-speaking countries and there is therefore no need to alter the form which has become familiar in those countries. Candle-power is similarly acceptable. The compound *isocandela*, on the other hand, replaces *isobougie* as well as *isocandle* and so we must put up with

* OED signifies the complete edition of the Oxford English Dictionary.

the unfamiliar hybrid in place of the familiar for the sake of international uniformity.

candle, candle-power. See CANDELA.

coefficient. A coefficient is a multiplier and dimensionless and so is a *factor*, and the two words have been used for similar purposes over and over again. Thus *utilisation factor* and *coefficient of utilisation* are both in current use on the other side of the Atlantic, while reflection factor has replaced coefficient of reflection only comparatively recently. The present tendency, at any rate in the literature of lighting, seems to be to use *coefficient* solely as a numeric and *factor* as the number which characterises a property involving a constant ratio between physical entities of like nature. This is not in accordance with practice in other branches of engineering, where coefficient of friction, expansion coefficient and the like show no signs of being superseded by friction factor, etc. In lighting matters the BSI uses *factor* and in the interests of uniformity it seems best to adopt this practice.

decibel. See LOG-UNIT.

decibrig. See LOG-UNIT.

direct reflection. See SPECULAR REFLECTION.

electroluminescence. This word was originally used to denote any process by which electrical energy could be directly converted into light, the most familiar example being the glow produced by an electric discharge through a gas or vapour. There has lately been a tendency to restrict it to light production from a phosphor subjected to rapidly alternating electric stress. This is to be deprecated since it destroys the analogy with photoluminescence (light produced by the action of light and, by extension, of u.v. and i.r. radiation on a phosphor) and thermoluminescence (light produced by heating a body to a sufficiently high temperature). If special terms are needed, the two forms of electroluminescence might be referred to as *discharge e.* and *condenser e.* respectively.

equality of brightness. See BRIGHTNESS.

equilux. See ISOPHOT.

equivalent. This word seems to have a fatal fascination for the loose thinker who cheerfully attaches it to some noun or other and uses the combination to denote something only very loosely connected with the meaning of the noun alone. An outstanding example is the term *equivalent foot-candle*, at one time used for the unit of luminance now called the *foot-lambert*.

The word has its legitimate use, however, as in *equivalent luminance*, meaning that luminance which is equal in luminosity, i.e., subjectively, to another luminance which differs from it objectively. Equivalent luminance was formerly called *apparent brightness*, but since the quantity is measurable in units of luminance, the use of the word brightness (q.v.) is now inadmissible.

factor. See COEFFICIENT.

fitting. See LUMINAIRE.

floodlight. The OED inserts a hyphen after *flood*, while the BSI gives *flood lighting* as two distinct words. By most writers on the subject, however, the word and all its derivatives are used single and unhyphened. The form to be used for the past tense and past participle is less easily settled. For *light* the OED gives both *lit* and *lighted* and there seems no strong tendency for either form to predominate. Matters are otherwise when the participle is used adjectivally; then the form is almost always *floodlighted*.

fluorescent tube. " ' When I make a word do a lot of work like that,' said Humpty Dumpty, ' I always pay it extra.' " If Humpty Dumpty had lived in the U.S.A. the word *tube* would have appeared near the top of his wages scale, for the duties it performs in American technological nomenclature are too numerous to reckon. A thermionic valve is a tube, a photocell is a phototube and now fluorescent lamps are fluorescent tubes. Although this use of the word does not, like the others, run counter to the OED definition of tube as a " long hollow cylinder," it is a description by form rather than by function. The English term is *fluorescent lamp* and if, for any reason, it is necessary to emphasise the form, the qualification *tubular* can precede the more general term.

foot-candela. See FOOT-CANDLE.

foot-candle. More argument has raged over the name of the unit of illumination in the British system than over any other term. The controversy was at its height at the turn of the century and *foot-candle* emerged triumphant over its rivals, among which it is interesting to note *candle-foot* (the name first used, but awkward in the plural), *candle-at-a-foot*, and even (after the pattern of mho from ohm) *candle-toof-toof*. The metric unit, originally called the bougie-mètre, presumably by analogy with the foot-candle, was quickly changed in 1896 to the convenient form *lux* and has given no further trouble, while the CGS unit, the *phot* (lumen per sq. cm.) is now seldom, if ever, used. Unfortunately no such happy result can be recorded for the British unit. The term foot-candle is admittedly clumsy, trailing clouds of the inverse square law after it, and various alternatives have been proposed from time to time. None has secured any measure of acceptance and a way out has been found by making use of the fact that the unit of illumination is equal to one unit of luminous flux per unit of surface area. The concept of luminous flux and its unit, the lumen, were not introduced until early in the present century, so that this solution of the problem was not possible when the term foot-candle was first introduced. There seems, however, much to be said now in favour of adopting the *lumen per square foot*, which is self-explanatory and reduces by one the number of special terms in the vocabulary of the lighting engineer. If the term foot-candle is retained, as it is in the U.S.A., it must be treated as a sturdy Anglo-Saxon and not hybridised as *foot-candela* (see CANDELA).

foot-lambert. The nomenclature of the units of luminance has a sad history. Originally luminance, then called brightness, was expressed solely in terms of luminous intensity per unit projected area, generally in candles per sq. cm. or per sq. inch. The former of these units was in 1935 officially given the name *stilb*; the latter was left unnamed. About 1915 lighting engineers began to feel the need for a unit of luminance readily derivable from the illumination of a surface and its reflection factor and so the *lambert* was defined as the luminance of a perfectly diffusing surface when its illumination was one lumen per sq. cm. As the unit originated in the U.S.A. it is difficult to understand why the CGS unit of illumination was chosen and the situation was made quite ironical by the strenuous opposition of André Blondel and other members of the French National Illumination Committee who maintained that luminance should be defined and measured only in terms of luminous intensity per unit area. Their opposition, however, failed to strangle the new-born infant and its use rapidly spread among American lighting

engineers, chiefly in the derived form of the millilambert which had a more convenient magnitude, since it approximated to the luminance of a perfect diffuser under an illumination of 1 foot-candle. The inconsistency between the units of illumination and luminance was, however, clearly illogical and in due course the millilambert was replaced by the foot-lambert, based on the British unit of illumination, the lumen per square foot. This unit is now very widely used by lighting engineers who work with British units, while those who work with metric units frequently employ the corresponding unit, the *apostilb*, derived from the lux in exactly the same way. Before the term foot-lambert was introduced, the same unit was sometimes employed under the name *equivalent foot-candle* (see EQUIVALENT).

The student of lighting and photometry is thus faced with two pairs of units of luminance. One pair, the stilb and the candela per sq. inch, are obtained by regarding luminance as the quotient of luminous intensity by surface area; the other pair, the foot-lambert and the apostilb, are defined by reference to the luminance of a specified surface under unit illumination. In 1951 the CIE made confusion worse confounded by introducing a special name for the metric unit corresponding to the stilb, i.e., the candela per sq. metre. This name was the *nit*, derived like stilb from the Greek and philologically impeccable but nevertheless in English quite unusable. Fortunately the name was dropped in 1955.

The CIE passed in 1951 and reiterated in 1955 a resolution that "a progressive reduction in the number of units of luminance is desirable." To give effect to this very praiseworthy recommendation it seems best to employ only two units, one of them being the candela per stated unit of area, which is completely self-explanatory. The unit of area may be the sq. inch, sq. cm., sq. ft. or sq. metre as may be convenient. The second unit on the British system should be the foot-lambert and on the metric system the apostilb. All other units, such as the stilb, the lambert and millilambert and the *skot* (10^{-3} apostilb) should be consigned to a merciful oblivion.

illuminating engineering. There has been recurrent criticism of this term ever since it was introduced. In the past objection was, for the most part, directed at the use of *illuminating* as an adjective qualifying the noun engineering, and it was urged that the word should be *illumination*. This is by no means easy to justify, however, without provoking a *tu quoque*, and the adoption of the term "Illumination Engineering" by the IEE in its examination syllabus is a neat example of the dangers which beset the over-fastidious, for does not consistency demand that another subject in the syllabus should be called "Electricity Engineering"?

A more cogent objection which has been made comparatively recently is to the use of the word *illumination* for what is now often referred to as *lighting*. The present-day conception of this technology embraces much more than the provision of illumination, and the practising members of the IES are officially described as "registered lighting engineers." It seems only common sense that if the fruit of an engineer's toil is lighting, he should be called a lighting engineer.

isocandela, isocandle. No hyphen. See CANDELA.

iso-foot-candle. See ISOPHOT.

isolux. See ISOPHOT.

isophot. During the years changes have been rung on the various possible combinations of iso- and equi- with lux and phot. The hybrids have been howled down, and of the two remaining forms the Greek has been adopted by the BSI, probably because the prefix iso- with the sense intended here is so familiar in other connections, e.g., isobar, isothem, isometric. In countries using the metric system, equilux or isolux is preferred because the use of the phot as a unit of illumination is being discouraged in favour of the lux. It is to be hoped that *iso-foot-candle*, which has made its appearance here and there recently, is doomed to be still-born, owing to the abandonment of foot-candle, in this country at any rate.

lambert. See FOOT-LAMBERT.

lantern. See LUMINAIRE.

level. The use of this word to denote some limited range of values of a quantity, particularly illumination and luminance, is often criticised, but it is difficult to find any other way of expressing what is meant without a clumsy periphrasis. It is used in such phrases as "general level of education" and "price level," so why not in "general level of illumination" (IES Code) and "luminance level"?

light-centre length. So hyphened (see "Modern English Usage," Article HYPHEN, 3A). It is interesting to note that in B.S. 161—1940 the correct form appears in the Contents and Definitions, but elsewhere there are either too many hyphens or too few.

lighting. See ILLUMINATING ENGINEERING.

log-unit. A convenient, if clumsy, expression for a ratio of 10 to 1. There is cetrainly need for some convenient way of expressing ratios. The need is especially acute in the science of acoustics, with its logarithmic scale of values, and this led to the false use of the *decibel* as a unit of sound intensity. This is now disallowed and the word is used only to denote a ratio equal to the antilog of 0.1. To avoid confusion other names have been suggested for this unit of ratio. One of the best seems to be *decibrig*, named after the inventor of common logarithms. Thus one log-unit is equal to 10 decibrigs; both are pure ratios and, unlike the decibel, have never been tainted by misuse to denote an absolute magnitude.

louver, louvered. So the OED, and very emphatically too, because later it goes on to say that "the form *louvre* arises from confusion with F. Louvre." Nevertheless, it is noticeable that at least half the examples given have the spelling thus deprecated. In French the only use of the word is in connection with the palace of that name. The F. equivalent of the "egg-crate" louver is *paralume*. The use of *louver* to denote this kind of structure seems altogether unfortunate, as the real meaning of the word is "arrangement of overlapping boards or strips of glass to admit air but exclude rain." However, it is probably too late now to substitute *grid* or *grille*. We might do worse than adopt the French term.

luminaire. This word, universally used in American literature to denote what in Britain is generally referred to as a *lighting fitting*, sounds as if it were French. Unfortunately the French word of the same form has quite a different meaning. Larousse gives "cièrges, torches dont on se sert à l'église pour le service divin." Under the weighty impact of American literature on lighting the French have begun to use the word in the American sense.

It cannot be denied that this is better than the British way of vacillating between *lighting fitting, lighting unit* (which in gas-lighting circles always includes the source as well as the hardware), *lantern* (used by the public lighting engineer) and, sometimes, *lighting fixture*.

In a crusading spirit, *Light and Lighting* made a courageous New Year resolution in 1954 to use only *luminaire* thenceforward for a "complete lighting unit consisting of a light source, together with its direct appurtenances, such as globe, reflector, refractor, housing and support" but the terms *fitting* and *fixture* were apparently left, along with *globe, shade*, etc., to denote a part or the whole of a luminaire from which someone had abstracted the light source. This is certainly implied in a later editorial (August, 1955) which states that it is "much better to tell him (the householder) the wattage of the lamps he must have in the kind of fittings he is likely to use. . . ."

It seems necessary to face the fact that what is required is a name for the complete unit, whether or not it has a light source, something which the average user regards as being fitted in his premises in order to provide light and therefore not unnaturally called a *lighting fitting*.

luminance. See BRIGHTNESS.

luminosity. See BRIGHTNESS.

lux. See FOOT-CANDLE.

mechanical equivalent of light. The mechanical equivalent of heat is the energy, in ergs or watt-secs, which would be obtained from the conversion, without loss, of one unit of heat. The term *mechanical equivalent of light* has been used for the number of watts which, if converted without loss to radiation at the wave-length of maximum luminous efficiency, would give one lumen. The analogy is so far-fetched that it is no wonder that the term has never been admitted into polite photometric society.

mile-candle. The term was formed on the analogy of *foot-candle* (q.v.) to denote the illumination produced by a source with a luminous intensity of one candela at a distance of one mile. The alternative of regarding it as an illumination of one lumen per sq. mile gives pause to the imagination and is not likely to be helpful. The use of the unit is practically confined to those interested in navigation, for whom a mile generally denotes a length of approximately 6,000 ft. Is it too much to ask that they should use the microlumen per sq. ft. and remember that the mile-candle is equal to one thirty-sixth of this unit?

millilambert. See FOOT-LAMBERT.

nit. See FOOT-LAMBERT.

nox. An unwanted unit of illumination, born of the war and the black-out. It equalled 10^{-3} lux.

phot. See FOOT-CANDLE.

photo-. Compounds formed with photo- should not be hyphenated. Of those which interest the lighting engineer the chief are: *photochromatic, photoconductive, photoelectric, photoemissive, photomultiplier, photoreceptor* and *photovoltaic*. The BSI does not share Fowler's view that "hyphens in the middle of words are no ornament, and admittance should be refused to all that cannot prove their usefulness."

photocell. This shortened form of *photoelectric cell* is convenient and there seems no good reason to discourage its use.

phototube. An American variant of *photocell* (see FLUORESCENT TUBE).

quotient. The result of dividing one quantity by another may be termed a ratio or a quotient, but the two words are not therefore necessarily interchangeable. A sum of money may be divided by another sum of money and the result is the ratio of one to the other. A sum of money may also be divided by a number of years and the quotient is an average annual income or expenditure. The simple rule is to use *ratio* when the two quantities concerned are of the same kind, but *quotient* when they are not. Thus reflection factor is the ratio of incident to reflected flux, while illumination is the quotient of incident flux by area. A ratio is always dimensionless, a quotient may be, but most often is not.

ratio. See QUOTIENT.

reflected glare. What is reflected is the light, or the source, not the glare. *Glare by reflection* is better.

regular reflection. See SPECULAR REFLECTION.

relative luminous efficiency. This name was adopted in 1951 for what had at different times in the past been called the *visibility factor*, and the *luminosity factor*. The word *factor* is clearly an unfortunate one (see COEFFICIENT), while *visibility* is a word in everyday use with quite another meaning and *luminosity* as a technical term is now reserved for the subjective correlate of luminance. The present name, cumbrous as it is, seems logically unobjectionable, especially when followed by the words *of radiation*, either expressed or understood. The unwieldiness, however, is a great drawback, especially if the term is used attributively, as in *relative luminous efficiency function*, or *relative luminous efficiency curve*. Unlike the name, the symbol V_λ has remained unchanged for many years and it is now not infrequently used attributively in place of the name, as in the expressions *the* V_λ *function*, or *the* V_λ *curve*. This practice is only justified by the necessity which knows no law and on no account must it be taken as a precedent.

skot. See FOOT-LAMBERT.

spectrum, spectral. Custom varies as regards the choice made between these words to qualify a particular noun. For example, *spectrum line* (or *band*) and *spectral l.* (or *b.*) are equally common. On the other hand, spectral distribution and spectrum locus are almost universal. In these circumstances, to formulate a rule would verge on the impertinent.

specular reflection. This graphic term has now been abandoned in favour of *direct reflection*, probably to secure uniformity of treatment for the analogous forms of reflection and transmission. The OED is helpful here and quotes the use of *specular* as applied to the surface but not the process. A safe rule is, therefore, to write *direct reflection* and never *specular reflection*, but to choose between *directly reflecting surface* and *specular surface*, using the latter form only when the nature of the surface, rather than its behaviour to direct light, is being considered.

stilb. See FOOT-LAMBERT.

utilization factor. See COEFFICIENT.

wave-length. The OED inserts the hyphen and the form *wavelength* is to be deprecated in spite of its adoption by the BSI, Science Abstracts and the Physical Society.

Association Française des Eclairagistes at Tours

At the meeting of the Association Française des Eclairagistes held at Tours from June 5 to 9 a number of papers covering a wide range of subjects of interest to lighting engineers were presented. At the opening meeting of the conference delegates were welcomed by the Mayor of Tours and by M. Jean Delooz, President of the AFE.

In the opening paper Jean Maisonneuve said that the increasing use of light sources with different colour rendering properties means that the lighting engineer must take a much greater interest in colour. In particular he must use his knowledge of light sources to advise users, architects and decorators on the type of light source best suited for any particular application or environment. He must therefore be fully familiar with the colour characteristics of light sources. Though these facts may be well known their application in practice is far from perfect. In particular the ultimate effect on colour rendering of inter-reflection of coloured light needs to be more fully understood. The theory of coloured light does not always work out in practice and it is therefore desirable that the colour rendering of different light sources in different surroundings should be studied under practical conditions.

School lighting

Two papers on school lighting were given. That by Dr. A. Dubois-Poulsen, an ophthalmologist, dealt first with the need for good lighting in schools. The first consequence of bad lighting is fatigue which leads to difficulties of accommodation and convergence with consequent headaches, and encourages harmful attitudes. Bad lighting, he said, does not however cause myopia, the important factors in which are heredity and growth. Nevertheless bad lighting certainly worries sufferers from ametropia more than other individuals. Good lighting is essential for efficient tuition. Furthermore in children acquired habits are conditioned and it is an advantage to make the school surroundings pleasant. He said that the level of illumination on desks should not be less than 25 lm/ft^2 and the daylight factor should nowhere be less than 5 per cent.

There is, however, said Dr. Dubois-Poulsen, the very serious problem of amblyopic pupils, i.e., those with an acuity less than 3/10. In Paris there is a tendency to group such children in specially lighted schools where they are taught by specially trained teachers. In such schools not only is a higher illumination provided but contrasts of things seen are greater. For children that cannot attend special schools Dr. Dubois-Poulsen recommended that special lighting should be arranged over their desks. In conclusion he said that good lighting is a greater necessity for the child than for the adult as it has important effects on the child's intellectual development.

The second paper on schools was by Dr. Merry Cohu, who discussed luminance and contrasts in the visual field, the brightness of sources and surfaces and the positioning of light sources. He also dealt with the transition from daylight to artificial lighting and with the lighting of various types of class and instruction rooms.

Photography, films and television

The Thursday morning was devoted to various aspects of lighting for photography, films and television. M. Jean Vivie described the development of light sources and equipment for both black and white and colour films. With the introduction of sound in 1926/28 it was thought that the arc would have to be replaced; however, the higher intensities required for colour films led to the retention of the arc lamp and to-day both arc and incandescent lamps are still widely used. He said that the possibilities of fluorescent lamps and xenon arc lamps for film studio work have not yet been fully explored.

Following this paper M. Maurice Deribere showed a number of excerpts from coloured films made in France in the production of which 3,200 deg. K incandescent lamps had been used.

The next paper, by M. P. Lemaigre-Voreaux, reviewed the development of the xenon arc lamp and its application to cinematography. The author thought that the short-arc lamp in particular showed great promise. The final paper in this session was by M. Andre Vigneau, who dealt with the role of lighting in photography and cinematography.

The Thursday afternoon was devoted to papers on the production of germicidal rays by Professor G. Dejardin, on the application of germicidal lamps by M. la Toison, and a review paper on the employment of plastic materials in lighting by M. Georges Fabre.

Two papers reviewing progress in standardisation of light sources and lighting equipment in France were given on the Friday morning by M. Henri Thesio and M. Robert Blancherie. M. Thesio dealt with lamps and accessories and also discussed progress in international standardisation. M. Blancherie reviewed the programme laid down in 1940 and reported progress to date.

The third paper on the Friday morning, by M. Chazal and M. Vedere, dealt with lighting from the point of view of the electricity supply industry. It was pointed out that over the whole of France 25 per cent. of the energy distributed was used for lighting (in Paris the figure is 40 per cent.) though the consumption per consumer on domestic lighting was very low being only an average of 120 kwh per annum. The paper dealt with the efforts of the industry to maintain steady voltage, a matter of importance with the growth of fluorescent lighting, and with the question of tariffs. The last part of the paper dwelt on the need for closer collaboration between manufacturers, contractors and sales organisations to bring about an improved standard of lighting generally.

Street lighting

On the Friday afternoon four papers on street lighting were given. The first, by M. Van Mossevelde, dealt with street lighting in Belgium, where fluorescent and colour-corrected mercury lamps are being widely used. The aesthetic advantages of fluorescent street lighting were also stressed in the next paper, by M. Louis Carlo, who described recent installations in Geneva. The third paper, by M. Andre Herzog, described the new lighting on the Champs-Elysees. The gas street lighting which was installed on the Champs-

Elysees in 1859 has recently been replaced by an installation employing colour-corrected mercury lamps with tungsten lamps to give improved colour rendering. New specially designed high columns have been erected but the existing low columns have been retained though now equipped with lamps similar to those in the new high mounted lanterns. The new installation has a consumption of 170 watts per linear metre and gives an illumination varying between 1.5 and 4 lm/ft^2 on the road surface. (A description of this installation appears on page 233.)

The last paper in the street lighting session concerned the lighting of the new tunnel at Le Havre and was given by M. Huet. There are in fact two twin one-way tunnels each 590 metres long and each having four tracks, for pedestrians, cyclists, slow traffic and fast traffic. At the tunnel entrances the illumination is 30 lm/ft^2 dropping to 3 lm/ft^2 in the middle of the tunnel then increasing to 15 lm/ft^2 at the exit. Lighting is provided by two lines of 40-watt fluorescent lamps. An interesting feature is that the entrance and exit of each tunnel is extended by a concrete vault 50 metres long in which are glass bricks the proportion or total area of which decreases from the outside towards the tunnel entrance thereby acting as a lead into the tunnel and helping to adapt the eyes of drivers to the lighting inside the tunnel.

At the closing session on the Saturday morning a lecture on "Light and Colour" was given by Professor Yves Le Grand, immediate past-president of the AFE. The lecture was very well illustrated by colour slides. Following this lecture a sound film of extracts from various sound and light spectacles was shown.

The conference was brought to a close by a lunch held in the caves of the wine growing district of Vouvray, a very successful function and an excellent way of ending a conference.

IES Forthcoming Meetings

CENTRES AND GROUPS

September 5th

BATH AND BRISTOL.—Visit to C. & J. Clarke Ltd., Street.

September 20th

LEICESTER.—Summer Outing—Lights of Leamington Spa.

September 24th

LEEDS.—Annual Dinner and Chairman's Induction. (At the Griffin Hotel, Boar Lane, Leeds), 7 p.m. for 7.30 p.m. Visit of President, Dr. W. E. Harper.

LEICESTER.—Interesting Lighting Jobs—Papers by Centre Members. (At the Demonstration Theatre of the East Midlands Electricity Board, Charles Street, Leicester), 6 p,m,

September 26th

TRANSVAAL.—Chairman's Address, by R. S. Yates. (At Room 95, Public Library, Johannesburg), 8 p.m.

September 28th

BATH AND BRISTOL.—" Lighting for Enjoyment," by T. O. Freeth. Joint meeting with E.A.W. (At the Royal Hotel, Bristol), 7 p.m.

BIRMINGHAM.—Chairman's Address, by V. A. Heydon. (At "Regent House," St. Phillip's Place, Colmore Row, Birmingham), 6 p.m.

GLOUCESTER AND CHELTENHAM.—Annual Dinner. (At the Belle Vue Hotel, Cheltenham.)

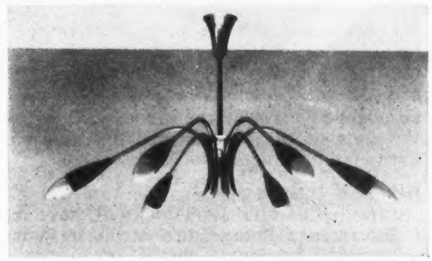
October 24th

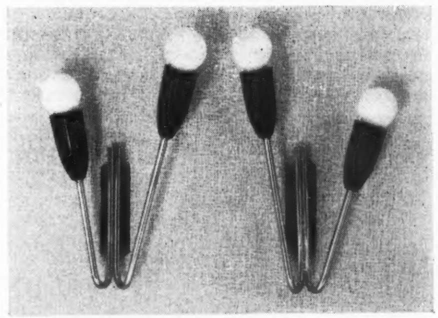
TRANSVAAL.—Annual General Meeting and Dinner. (At the New Club), 6 p m.

NEW PRODUCTS

Decorative lighting fittings

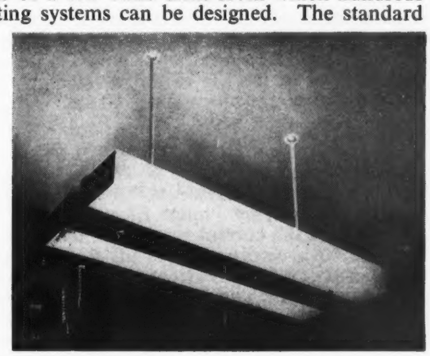
Oswald Hollman Ltd. (208, Kent House Road, Beckenham, Kent) have introduced a new range of ceiling fittings and wall brackets specially designed for use with small internally silica-coated tungsten lamps. Illustrated is a six-light pendant of polished brass with coloured sconces (price £9 15s. 6d., plus £1 18s. 2d. P.T.), and a pair of wall brackets of polished brass with black backplates and black, white or coloured sconces. They can also be supplied with polished brass backplates with black arms and coloured sconces. (Price per bracket, £3 2s., plus 12s. 1d. P.T.).





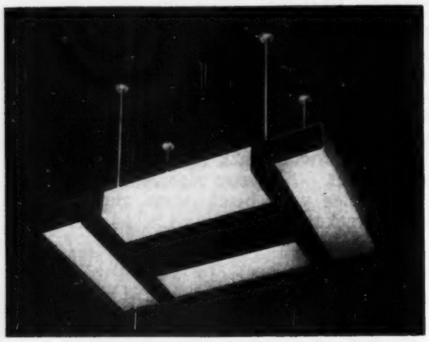
'Domino' fluorescent lighting system

The new Thorn Electrical Industries Ltd. "Domino" system of fluorescent lighting specially designed by John Reid offers new scope for imaginative lighting in modern architecture. It consists of a few basic units from which hundreds of original lighting systems can be designed. The standard



rectangular "Domino" fluorescent unit comprises a sheet steel chassis finished "matt black" and a white opal (040) "Perspex" diffuser cover. It can be suspended from the side of the metal chassis or from the back. A series of adaptor brackets and plates are available which enable the basic units to be mounted in a variety of ways—side by side, back to back, horizontally in various patterns, and vertically as single or multi-unit pendants. The chassis accommodates glow-switch or "Quickstart" control gear and one, or two, 5-ft., 4-ft., or 2-ft. fluorescent lamps supported by spring-loaded bi-pin lampholders. The opal diffuser clips inside

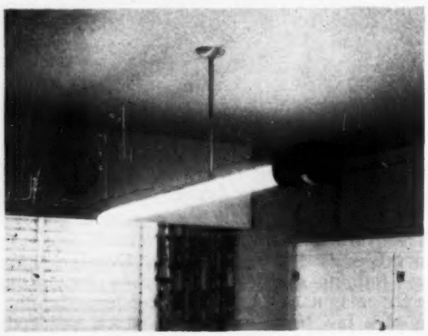
the metal chassis and, although rigidly locked in position, it can be removed easily for cleaning by pressing the sides of the diffuser together. Metal-end diaphragms with $\frac{1}{8}$-in.-deep indentations of rectangular section are fitted to the chassis. This allows an open-ended metal jointing piece to



be clamped between continuously mounted fittings, spacing the ends of the chassis, allowing a gap of $\frac{1}{4}$ in. between diffusers when continuously mounted.

Kitchen lighting unit

Thorn Electrical Industries Ltd. have recently introduced a fluorescent lighting unit (see illustration) specially for use in domestic kitchens. The "Kitchenlight" is supplied complete and ready wired with starter/ballast lamp, fluorescent lamp and suspension set. To install, it is only necessary to fix the ceiling plate to a standing central ceiling point and connect the wiring. The short suspension rod slides along the horizontal rod until the latter is correctly balanced and is



then screwed well home to prevent unnecessary movement. A 4-ft. 40-watt fluorescent lamp is used with a combined starter/ballast tungsten lamp, which is concealed in a red shield, open at the top to throw light up to the ceiling and slotted below for decoration effect. The total weight is 2 lb. The unit is suitable for 230/250-volt A.C. only. The price is £2 14s., plus 11s. 8d. P.T.

Enlarger lamp

A new "Photocrescenta" opalised enlarger lamp has been introduced by Philips Electrical Ltd. and will eventually succeed the current type. The development of new process of flush opalising gives all the even light distribution associated with the current type lamp, plus greater light transmission and improved heat distribution. They are available in the 110-, 210-, 230-, 240- and 250-voltage range. The 75-watt lamp costs 3s. 9d. and the 150-watt lamp 4s. 9d.

Portable fluorescent unit

A portable fluorescent lighting unit has been introduced by Engineering Developments (England) Ltd. It can be adjusted to throw a concentration of shadow-free light in any direction. The unit, which uses a 2-ft. 40-watt fluorescent lamp working on 230- or 240-volt mains, can be swivelled through 180 deg. and the reflector tilted at any angle. In the horizontal position the light is only 10 in. from the ground, so that it can be slipped under vehicled or other objects and the reflector placed, if required, to throw the light directly upwards. The overall height of the unit with the lamp in a vertical position is 3 ft. 6 in. The control gear is housed in the base. The unit is designed to withstand rough treatment.

Opal glass fittings

A number of new opal glass fittings have been introduced by the A.E.I. Lamp and Lighting Co. Ltd. Included in the selected range of commercial filament fittings, they are available in open or closed versions for rod or chain suspension or ceiling mounting. The new "Brandy Glass," "Acorn," and "Mushroom" designs are available in a variety of sizes.

Screw-neck watertight well-glass fitting

The A.E.I. Lamp and Lighting Co. Ltd. have also introduced a new watertight screw-neck well-glass fitting for use with G.L.S. lamps up to 100 watt. This fitting, available with or without a reflector, consists of a smoothly contoured die-cast aluminium canopy threaded to carry the screw-neck well-glass bowl. (Price, £1, plus 6s. 8d. for reflector, if required.)

Circular bulkhead fitting

A new circular bulkhead fitting by the A.E.I. Lamp and Lighting Co. Ltd. is of cast-iron, with a clear-glass front secured by a brass retaining ring with three fixing screws. This fitting is made virtually dustproof and waterproof with the addition of a rubber gasket. A porcelain B.C. lampholder for 60-100-watt G.L.S. lamps is included. (Price, £1 14s. 9d.)

Domestic fluorescent fitting

H. W. Field and Son Ltd. have introduced a fluorescent lamp fitting for domestic use which is suitable for ceiling fixing, suspension or wall mounting. The silent gear is housed within the unit and the lamp is diffused by a sectional polystyrene plastic louvre. Three sizes are available: 4-ft. 40-watt and 3-ft. 30-watt for general lighting, and a 2-ft. 20-watt for halls or wall mounting. All three have keyholes for easy fixing for either horizontal or perpendicular wall mounting. The diffusers can be supplied in clear, yellow, gold or green. The fitting is finished in bronze. Prices with clear diffusers: 4-ft. 40-watt, £5 10s., plus 13s. 11d. P.T.; 3-ft. 30-watt, £5 3s., plus 12s. 4d. P.T.; and 2-ft. 20-watt, £3 13s. 6d., plus 7s. 6d. P.T. Coloured diffusers are slightly more expensive.

8-ft. fluorescent fittings

Following the announcement of large-scale production of Atlas 8 ft. 125-watt fluorescent lamps, Thorn Electrical Industries introduce two new "Atlas" batten fittings to accommodate these lamps. The new fittings are for single or twin lamp operation, with all gear totally enclosed in a welded steel chassis finished in "Portland Stone" enamel. The units can be attached flush to the ceiling or suspended by rod or chain. Attachments are available to convert the fitting into a direct lighting reflector, and "Clipluve" diffusers can also be used if desired. Modifications have also been carried out to "Atlas" fluorescent trunking, so that continuous lengths of 8-ft. lamps complete with gear can be accommodated.

Trade Notes

Chemically brightened aluminium

The London Aluminium Co. Ltd. will shortly be operating under licence the "Erftwerk" process for chemically brightened aluminium. The process, which is simple and economical, was originally developed in Germany but is not yet widely known in this country. The process provides protection against attack from the worst industrial and marine atmospheres. In the German car industry super-purity aluminium treated in this way is being used instead of chrome-plated steel.

8-ft. fluorescent lamps

As from June 1 the price of 8-ft. fluorescent lamps manufactured by the G.E.C. Ltd., A.E.I. Lamp and Lighting Co. Ltd. and Philips Electrical Ltd. were reduced from 32s. 6d. to 25s. each.

Change of address

Lumenated Ceilings Ltd. have acquired larger Scottish sales offices at 10, Bothwell-street, Glasgow, C.2. (Telephone: Glasgow Central 6571-2.)

Identification of fluorescent lamps

To assist dealers in the rapid identification of lamp colours, the sleeve ends of Philips fluorescent lamps are now sealed by a strip of tape which is distinctively coloured and bears the name of the tube colour in bold type. A special leaflet, which can be pinned up at some convenient point in stores or warehouses, has been issued. This illustrates the tape colours and indicates the lamp colours to which they refer.

The coding is as follows:—

Tape Colour	*Fluorescent Lamp Colour*
White.	White (3,500 deg. K).
Pale Blue.	Cool White De Luxe (Natural).
Dark Blue.	Cool White (Daylight).
Orange.	Warm White (New Warm White).
Maroon.	Warm White De Luxe.
Green.	Colour Matching.

Trade Literature

HERMAN SMITH SMITHLITE LTD., Empire Works, Dudley, Worcs.—Introductory leaflet illustrating in colour some of the new range of "Smithlite" fluorescent lamps which dispense with the standard bi-pin and bayonet cap lamp ends.

PHILIPS ELECTRICAL LTD., Century House, Shaftesbury Avenue, London, W.C.2.—A new twelve-page booklet, in colour, entitled "Fluorescent Lighting for Ships" dealing with fluorescent lighting for ships and information regarding its application.

CROMPTON PARKINSON LTD., Crompton House, Aldwych, London, W.C.2.—A fully illustrated pocket-size booklet giving full details of the Company's latest fluorescent and tungsten lighting fittings, including prices.

Due to alterations made after going to Press, the prices quoted in the SIMPLEX ELECTRIC CO., LTD.'s "Screwglass" advertisement appearing in the August issue were incorrect. The correct prices are: vitreous enamel, 13s. 6d.; cast aluminium alloy, 12s. 6d.

Correspondence

Street Lighting

Dear Sir,—"Lumeritas," in your July issue, mentioned the police theory that the siting of street lighting columns contributed to the recent Yorkshire road accident involving nine deaths, and suggests that this possibility ought to be tested. I am quite sure that there is no need to test the possibility of any driver getting into trouble by "lamp hopping," and equally convinced that no system of lantern siting can be evolved which eliminates danger from this practice. Would it not be far better to establish once and for all in the minds of drivers, and of the police, that street lanterns are neither guiding beacons nor signal lights but merely a means of providing visibility of, and on, the road? This would appear to be a self-evident proposition, but apparently it is not so to judge by the efforts constantly being made to use the placing and, in some cases, the type and colour of light sources for purposes other than that of producing maximum road visibility.

A driver should be looking at the road and nowhere else, and if he cannot see where the road is going he should put on his headlamps and drive within their range. The alternative of "following the lights" is so suicidal, and homicidal that the Highway Code ought to contain a section barring the practice. Should we not also point out to the relevant police authorities that there is no parallel between the use of bull's-eye lanterns and street lighting lanterns.

London. W. ROBINSON.

Situations

Vacant

ILLUMINATING ENGINEER, capable of preparing lighting schemes and estimates for modern emporiums and commercial buildings. Applicants should have experience in dealing with large and individually designed light installation. Experience in the design of the special light fittings and the general knowledge of the electrical contracting industry would be an advantage. The job offers scope for applicants with initiative, and in the first place you should apply, stating technical qualifications and experience, to Mr. G. K. Medlock, A.M.I.Mech.E., Chief Engineer, C.W.S. Limited, Engineering Office, Hanover Street, Corporation Street, Manchester 4.

Philips Electrical Limited have a vacancy for a DRAUGHTSMAN in the Lighting Fittings Design Department of their London Head Office. Some drawing office experience in fluorescent lighting fittings or similar light industrial equipment is necessary. A knowledge of sheet metal work, electrical installation and wiring is desirable. Please reply to the Personnel Officer, Century House, Shaftesbury Avenue, London, W.C.2.

An ASSISTANT to a Senior Executive engaged in the commercial activity of a large Electric Lighting Manufacturer is required in London. Applicants should be men between ages 25 and 32 years with a professional engineering qualification preferably of degree standard. For older candidates some experience in the field of lamps and lighting is desirable. Duties will be varied and cover those responsibilities, experience of which forms essential training for promotion. Salary range £650-£1,000 per annum with bonus and pension. Replies to Box No. 924 quoting reference No. 847.

C & G Examination Results

The results of the City and Guilds of London Institute examinations in illuminating engineering held earlier in the year have just been announced and are as follows:—

Intermediate Grade

First Class.—J. R. Barker, J. W. Carlton, R. A. Chappell, W. B. Dinwoodie, R. J. Fothergill, F. R. Grant, B. Morgan, B. Ruston, G. M. Whittle.

Second Class.—N. E. Beckett, M. F. M. Bowser, R. A. Bullock, W. Burt, A. V. Cale, B. H. Cross, G. D. Deacon, M. J. Hall, R. W. Hiscoke, N. J. Jenson, E. P. Lee, D. J. Lyons, K. Moore, K. E. Parsons, M. C. H. O'Neil Shaw, T. N. Stevenson, J. A. Ward, M. J. Wells.

Final Grade (Papers 1 and 2)

First Class.—G. V. McNeill, A. R. M. Spalding, Miss J. L. Stewart, R. W. Taylor, M. Wood-Robinson.

Second Class.—F. M. Bonin, S. J. Chasey, W. K. Lumsden, E. G. Maddock, R. McLagan, M. W. P. Pegg, J. C. Procter, J. Szahidewicz.

Final Grade (Papers 1 and 3)

First Class.—G. V. McNeill, B. O'Dwyer, R. W. Taylor.

Second Class.—C. H. Bedwell, F. M. Bonin, S. J. Chasey, R. L. Gardner, K. H. W. Last, D. J. Lenthall, E. G. Maddock, C. J. Martin, R. McLagan, M. A. Ryle, M. Wood-Robinson.

Miscellany

Overseas Agents

Suppliers of raw materials and makers of machinery for the manufacturing of incandescent lamps, fluorescent lamps, radio valves, neon signs, interested in appointing agents for the Indian market, please contact us. Excellent references would be furnished. New and secondhand machines for the manufacture of radio valves (laboratory scale), fluorescent lamps, miniature lamps and mercury vapour lamps required now. Inter-Continental Exports and Imports, 522, Diagonal Road, Visvesvarapuram, Bangalore-4 (S. India).

Errata

The Benjamin floodlight shown on page 193 of the July issue is the large specular type and not the "Duoflux" as captioned.

POSTSCRIPT By " Lumeritas "

THE TACTICS of the suffragettes were adopted recently by a well-known sculptor in an endeavour to prevent the removal of a century-old ornamental gas lamp from the road in which he lives. He had himself chained and padlocked to the lamp post so that the men sent to haul it from its site with a mobile crane could not proceed with the work. However, after parleys with the police and the city surveyor, and having made his protest in no uncertain manner, he was unchained and presented with the gas lamp, which he intends to erect near the studio in his garden! This incident was provoked by the local authority's decision to replace the gas lamps with spun concrete electric standards, which seem nowhere to commend themselves to aesthetes. " Some terribly ugly things are being done in the name of modern public lighting," said the sculptor's wife, who is herself a painter, and there is no denying that her view is shared by numerous people. It is, of course, useless to dispute about matters of taste but, as a writer in the *Municipal Journal* points out, those who resent the replacement of old street lamps should realise that the local authority has a duty to light roads efficiently and for the benefit of all users—not for the residents only. Nor do the lovers of gas lamps—dating, *vide* the *Evening Standard*, from the 199th century!—show their affection for old-time lighting equipment to the extent of lighting their homes by gas fittings of the period.

" PROBABLY one of the most prolific causes of the alarming deterioration in the general standard of eyesight in recent years has been the advent and increasing use of fluorescent lighting." These are the opening words of an article on " Light and the Eye," recently published in *The Recorder* and based on the views of a certain persistent anti-fluorescent propagandist. There is, in fact, no evidence of any recent " alarming deterioration in the general standard of eyesight," and so it is idle to speak of its causes—prolific or otherwise.

The basis for alleging such a deterioration is the number of persons supplied with glasses under the National Health Service. Large as this number is, it does not enable any conclusion to be drawn as to the comparative general standard of sight before and after the advent of fluorescent lighting, for there was no N.H.S. in pre-fluorescent days and, consequently, not only no comparable records of glasses supplied but also no " free " issue, which in the early years of the N.H.S. undoubtedly induced many people to have their sight tested and to accept glasses for the correction of minor refractive errors. Errors of refraction are not produced by any form of lighting. And though, perhaps, not so generally corrected, they were as prevalent before the advent of the N.H.S.—and so as prevalent before the contemporaneous advent of fluorescent lighting—as they are now. Of course, one of the most familiar tricks of the propagandist is the type of question-begging statement quoted above. The pity of it is that there are many uncritical people with whom it will pass as factual.

ANOTHER, and rather ambiguous, reference to artificial lighting and the demand for glasses recently appeared in *The Optician*. Reporting the fact that an optician has been chosen as the next Master of the Tallow Chandlers Company, the journal asks, is there any justification in claiming that this appointment is not wholly irrelevant because *the production of sources of artificial lighting has been a factor in creating a bigger demand for glasses?* Now the answer to this question is *Yes*, only if the statement I have italicised is true: but is it? The answer is *No* if the statement means that the production of sources of artificial lighting has been a factor in creating more of the ocular anomalies that can be " corrected " by wearing suitable lenses and prisms. On the other hand, the production of sources of artificial lighting has made it possible to turn night into day—it has made the pursuit of photopic visual tasks possible " all round the clock." So, it may well have created a bigger demand for glasses in so far as artificial lighting is, or has been, so stinted in practice as to show up otherwise negligible optical shortcomings. But, of course, coincident with the rapid development in modern times of better and better sources of artificial lighting there has been a great increase in commercial and industrial occupations which entail close or fairly close seeing, for which the large fraction of the population which is developmentally more or less " long-sighted " is not ideally suited. Hence, more of such people find glasses helpful—even in daylight—than is the case in substantially agricultural communities.

ANOTHER reason for the bigger demand for glasses is that they are no longer thought—by either sex—to be detrimental to personal appearance, often, indeed, they are considered either decorative or impressive—according to the sex of the wearer. Resistance to the adoption of glasses by those to whom they can be of assistance is far less than it was in the recent past, when the wearing of glasses was felt by many people to be a prejudicial admission of defective vision, or of being too old for further employment. Ophthalmologists know that something like 98 per cent. of people are more or less ametropic, but many of them have such slight defects, and do so little highly exacting seeing, that it is quite unnecessary for them to wear glasses. But, that there is now a large demand for glasses is not in the least surprising and is a welcome indication of the growing health-mindedness of people. It was said that the low standards of artificial lighting of the last generation were responsible for much eyestrain. Now we are asked to believe that the higher standards of to-day are responsible for a rising demand for glasses ! What nonsense it is!

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